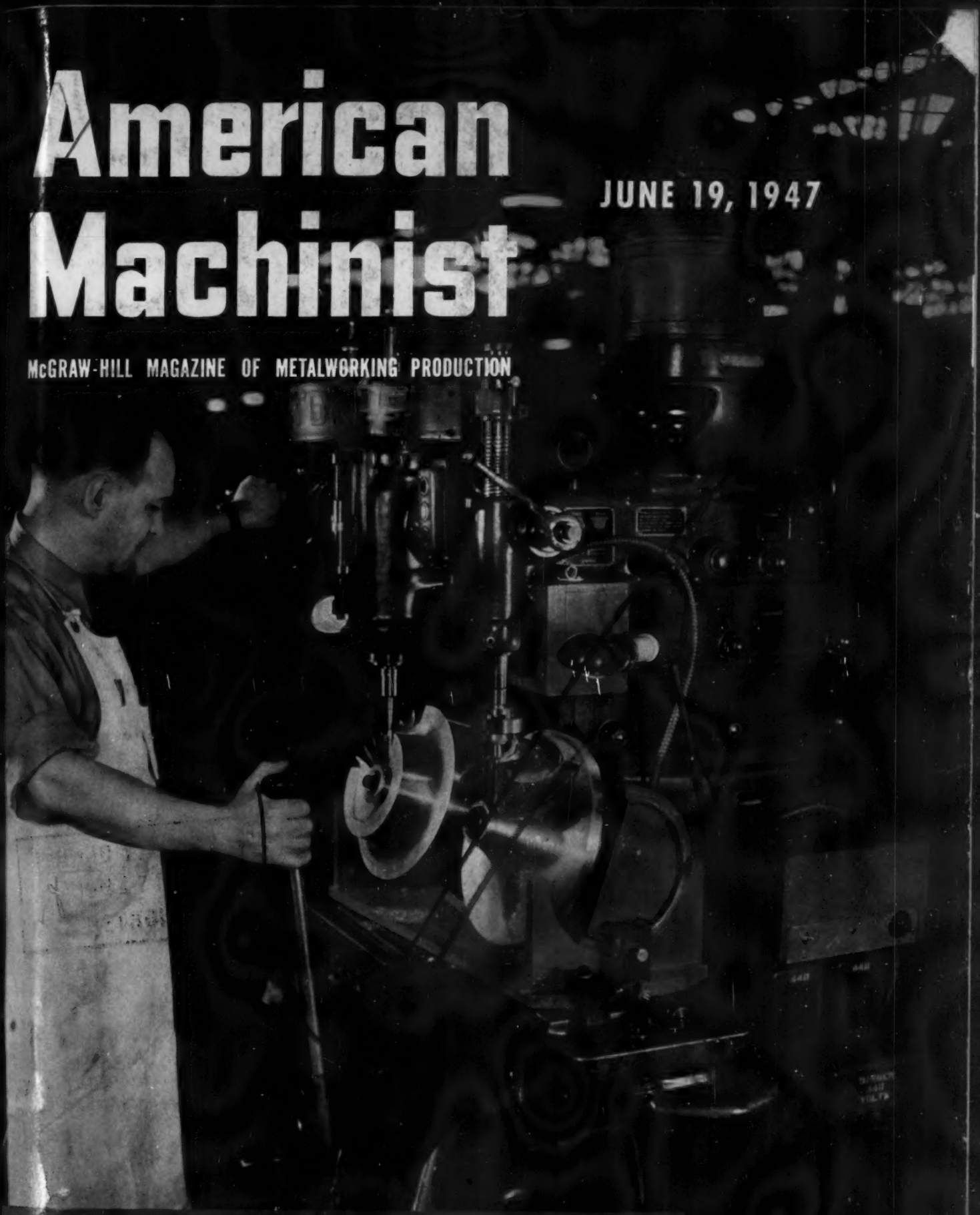
American Machinist

JUNE 19, 1947

McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

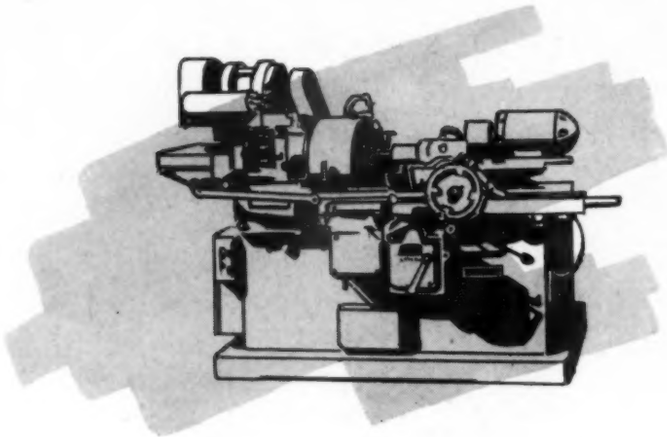


TONE STYLUS CONTROLS DUPLICATING

PRECISION CASTING — a special report

DRAWING AND REDRAWING THIN-METAL SECTIONS

Don't let your WAR ASSETS



turn into LIABILITIES

● A message of vital importance to purchasers of surplus Heald Machines

IF YOU HAVE PURCHASED a Heald machine out of war surplus, you are faced with both an *opportunity* and a *challenge*.

An opportunity to produce *more* parts, at limits of accuracy possibly beyond anything you have ever required before.

And a challenge to produce them *at the lowest possible cost per part*. Because every Heald machine has the inherent ability to do just that—though usually tooled for a specific job.

Your job may be different. That doesn't mean you've got the wrong machine. But probably it should be retooled, or possibly even rebuilt. And no one is better equipped to do that than the original manufacturer.

Heald engineers know what every one of the Heald machines now in war surplus was expected to do—*and what it can do for you*. These engineers have years of experience to draw on, and the most extensive files on precision finishing problems in the world.

We want to go on building, and selling, the finest precision machine tools made. And we know that the only way we can do that is to help you get the most out of every Heald machine you buy—surplus or brand new. Feel free to contact us here in Worcester or at any of our branch offices. THE HEALD MACHINE COMPANY, Worcester 6, Mass.

HEALD

means more precision
. . . less cost

Branch Offices in Chicago • Cleveland • Dayton Detroit
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American Machinist

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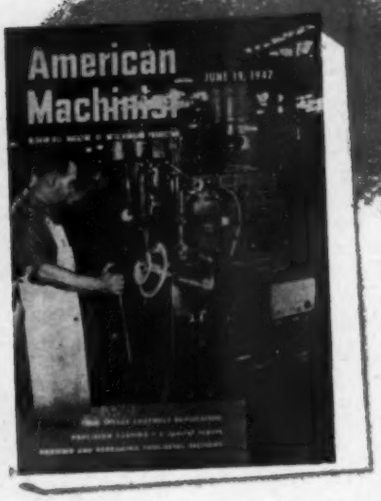


Chips and QUIPS

Machining to Sound . . . Both the operator's eyes and ears help him control milling of thin contour sections on this centrifugal impeller for aircraft turbosuperchargers. The setup, at Lynn River Works of G.E., includes direct audio signal through a loudspeaker (red box behind stylus) which translates stylus pressure and deflection into change of pitch, enabling the operator to maintain a predetermined pressure on the cutter. Displacement of 0.0001 in. at a pressure of a few ounces changes the pitch. The Kodachrome, by Wm. Redfern, illustrates an article in this issue.

Casting . . . To bring you as straight and unbiased a story as we know how on precision casting and its applications, Assistant Editor Van Voast has been back and forth between New York and the Mississippi and up and down the East Coast. From the welter of conflicting reports and opinions, and dozens of plant visits, he has assembled 16 pages of important facts. They make up our Special Report in this issue. Reprints? On request.

Contrast in Drawing . . . We've gotten Wallace Mills to give you another of his articles on thin-metal stamping, this time dealing with drawing and redrawing to avoid wrinkles and tearing. The answer is good design of dies and product, plus careful workmanship and sensible care . . . For contrast, the next article describes a new technique for drawing plastic sheet with skeleton molds contacting critical points only. This cuts mold cost, prevents marring, and simplifies forming of housings, shields, cases and covers.

Press Fits . . . Prof. Dr. Ing. Sawin (see biog.), who has been a regular contributor to *A.M.* for the past two decades, gives us in this issue a comprehensive report on calculations for shrink fits on large gears and wheels. While most American plants use arbitrary rules or cut-and-try for such fits, Dr. Sawin provides here the calculations essential for larger pieces. They expand the uses and applications of the method in normal plant work.

Mechanized Welding . . . Integrating materials-handling devices and welding fixtures at American Welding & Mfg. Co. cut prices on petroleum-storage units, and provided us with an excellent picture-caption story showing the advantages of methods analysis. Continuous line production saved man-hours and space.

Thoughts for Today . . . "The sweetness of low price never equals the bitterness of low quality" . . . "Advertising is the fine art of making you think you have longed for something all your life that you've never heard of before."

Close Shave . . . There's frequently a lot of tricky machining on familiar products that we take for granted. As an example, we show in pictures and captions the complications involved in obtaining the hairline (literally) precision involved in milling heads for electric shavers at Collam Mfg. Co. . . . And to keep your handbook of materials up to date, we've described in detail the characteristics of boron carbide. Developed some years ago, its wartime applications were legion and largely unpublicized—so we felt you'd like to know more about the hardest material man has developed thus far.

Coming . . . In *A.M.* for July 3: Induction hardening methods at Jones & Lamson, a special report on quenching media and fixtures, articles on checking surface roughness of castings, hobbing non-metallic gears, guards for punch presses, conservation at Fisher Body-Ternstedt and the start of a 3-article series on electric-furnace brazing. There'll also be another unit in our pre-Show series about machine tools—a series which, by the way, is being provided in four bonus pages added to each regular issue between May 22 and the Show issue itself on Sept. 11.

STANDARDS MAN . . . This past March 20, Prof. N. N. Sawin observed both his 70th anniversary and his 45th year in research and scientific work in connection with metalworking. Born in Caluga, Russia, and educated there and in the St. Petersburg Technological Institute, he became assistant, then professor and metals laboratory chief at the Institute. He was consultant on tools for Putilovworks, mobilized Russian industry for arms production in World War I, developed manufacture of H.S.S. and managed Russian A.E.G.

He emigrated from Russia in 1920 and soon joined Skodawerks in Pilsen where he became chief of the research laboratory in 1932. He has taken an active part in the Internl. Stds. Assn. and in research on cutting, wear of materials, measurement, general standardization and tolerances. In 1945, Soviet arrival in Prague forced him to move to the American zone. His latest article is in this issue.

QUENCHING WITHOUT DISTORTION

Gleason No. 26 Quenching Press

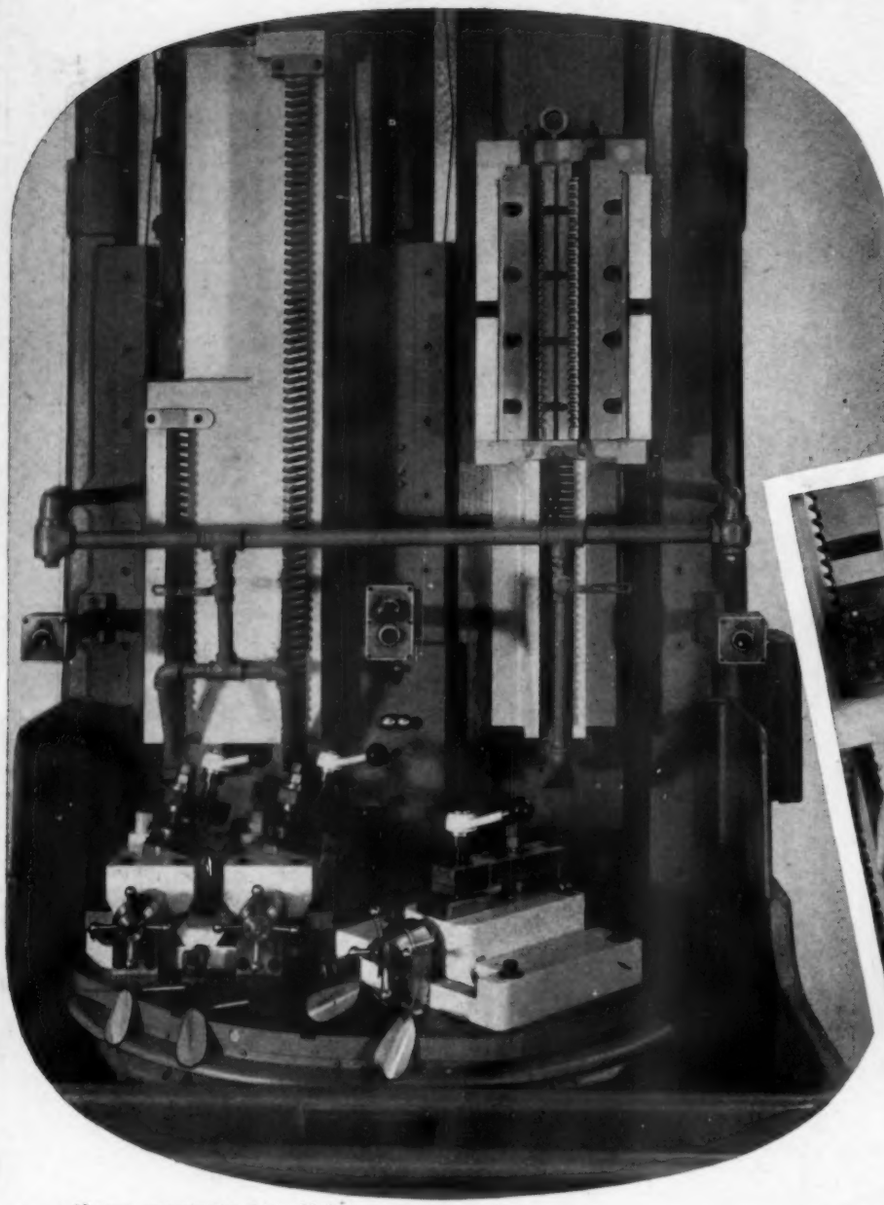
. . . a larger machine to handle larger gears, discs, liners, bearing races, etc.

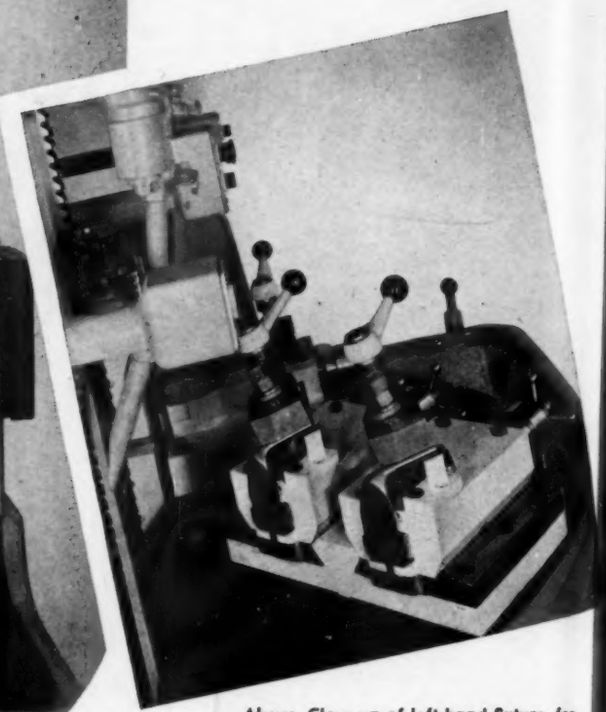
The Gleason Quenching Presses are an integral part of every industrial unit where the heat treatment of metal parts is required. Designed for faster production . . . distortion-free quenching of bevel and hypoid gears and innumerable other parts that must be quenched to close tolerances.

GLEASON Works
1000 University Avenue
Rochester 3, N.Y., U.S.A.

Builders of Bevel Gear Machinery for Over Eighty Years

How

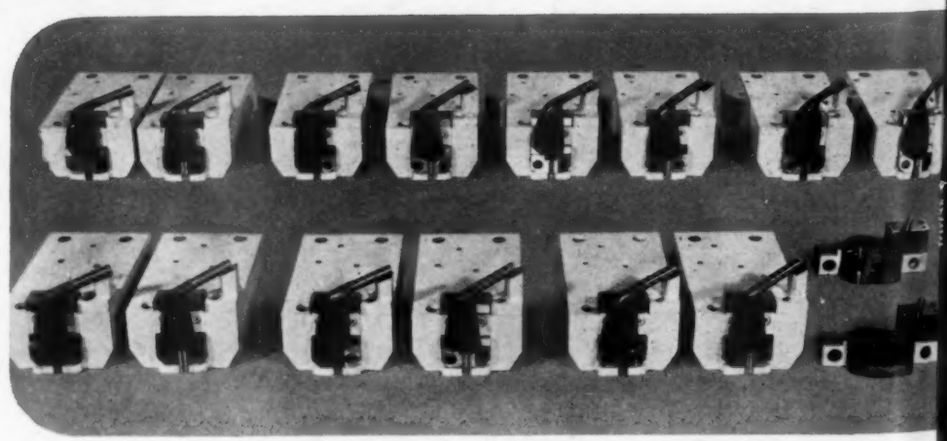




Above: Close-up of left-hand fixture, for broaching the groove and back of the club head.

Above: CINCINNATI No. 10-66 Vertical Duplex Hydro-Broach, tooled up by Cincinnati Application Engineers to broach golf club heads. Catalog M-1387-1 contains specifications of the Standard Duplex Machine.

Right: These blocks are interchangeable in the fixtures for 11 different golf club heads broached on one machine.



See the
CINCINNATI MILLING DISPLAY
at the MACHINE TOOL SHOW,
Chicago, Sept. 17-26

THE CINCINNATI MILLING

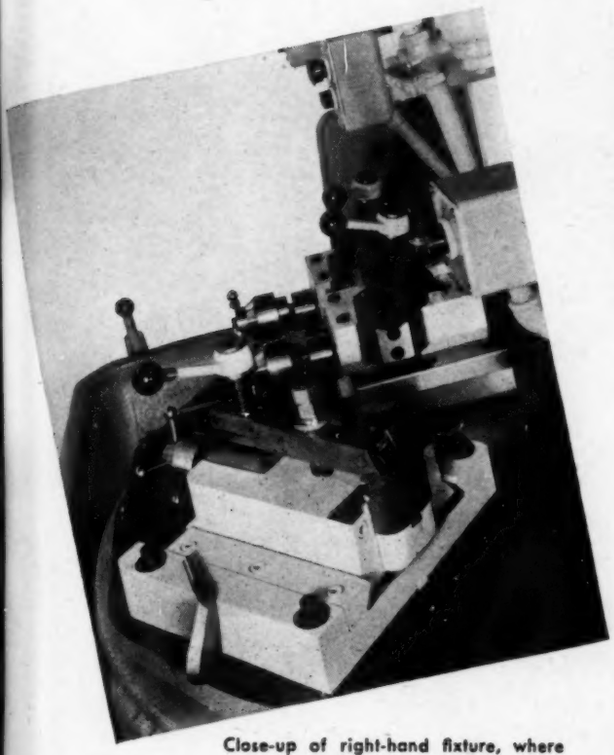
MILLING MACHINES

Direct field engineering offices: Boston 16, Massachusetts • Buffalo 7, New York • Chicago 12, Illinois • Cincinnati 9, Ohio • Cleveland 3, Ohio

to play a stymie

. . . in manufacturing golf clubs

CINCINNATI



Close-up of right-hand fixture, where the sole line, toe and heel of the club are broached.

● Maintaining accuracy of weight was a costly operation for a manufacturer of golfing equipment, so he turned to broaching as a means of raising quality standards and overcoming the stymie of high costs. ¶ Working in co-operation with the customer (MacGregor Golf, Inc.), Cincinnati Application Engineers devised the equipment illustrated here for a CINCINNATI No. 10-66 Vertical Duplex Hydro Broach, to broach club heads in three progressive stations. The degree of success created by this radical departure from established methods may be gauged from the weight tolerances which are now held for matched sets . . . within $\frac{1}{16}$ ounce.

> In two fixtures under the left-hand ram, the back of the club head and a formed groove are broached. In the right-hand fixture, the sole line, toe and heel of the club are broached. *Production is over 100 club heads per hour complete.*

Perhaps many of the parts in your shop now being finished by other methods could be Cincinnati broached more economically. Whether they weigh an ounce or two, or several hundred pounds, Cincinnati Broach Engineers will be glad to work with you and devise equipment for broaching them faster and at lower costs.

MACHINE CO. CINCINNATI 9, OHIO, U. S. A.

BROACHING MACHINES • CUTTER SHARPENING MACHINES

Detroit 2, Michigan ● New York 17, New York ● Philadelphia 40, Pennsylvania ● Pittsburgh 22, Pennsylvania ● Syracuse 2, New York ● West Hartford 7, Connecticut.

THREE STEPS TO *Smoother Power*

PRE-SHAVING ON THE FELLOWS GEAR SHAPER

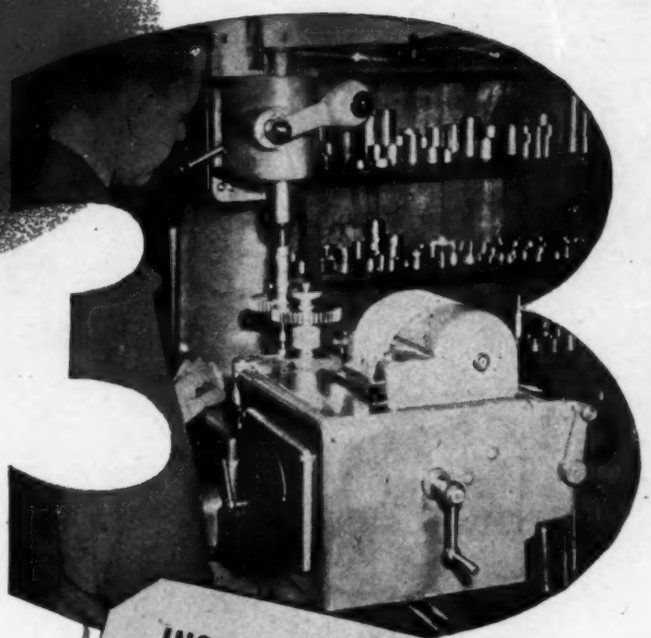
Gears are precision-cut on the 6-A Type Gear Shaper.

SHAVING ON THE FELLOWS GEAR SHAVING MACHINE

Low cost finishing on the No. 18 Gear Shaving Machine assures quieter action at all loads and speeds.

• **HAVE YOU SEEN** the latest in gear science... the Fellows sound motion picture in natural color..."Highlights of the Art of Generating and Gear Manufacturing Equipment." Contact Springfield, Vermont, or our local offices for booking appointments.

THE FELLOWS METHOD... MACHINES AND TOOLS FOR



INSPECTION ON THE FELLOWS RED LINER

Checking on the Fellows No. 20M RED LINER ensures positive control over gear accuracy.

Prominent Lathe Builder Relies on the Fellows Method for Production of Smoother, Quieter Gears

Along with the demand for increased power and higher speeds, the positive quieting of all gear mechanisms has become the order of the day. The Sidney Machine Tool Company, Sidney, Ohio, for instance, finds that the quiet, smooth operation of Fellows-produced spur gears in their 12-speed headstock favorably affects salability of the lathe. Precision gears give Sidney Lathes greater operating efficiency, longer tool life, and quieter machine operation.

For full information on how to bring a new degree of quietness and precision to your machines, write for our illustrated book, "The Fellows Method" or present your problems to: The Fellows Gear Shaper Company, Head Office and Export Department: Springfield, Vermont, Branch Offices: 616 Fisher Bldg., Detroit 2...or 640 West Town Office Bldg., Chicago 12.

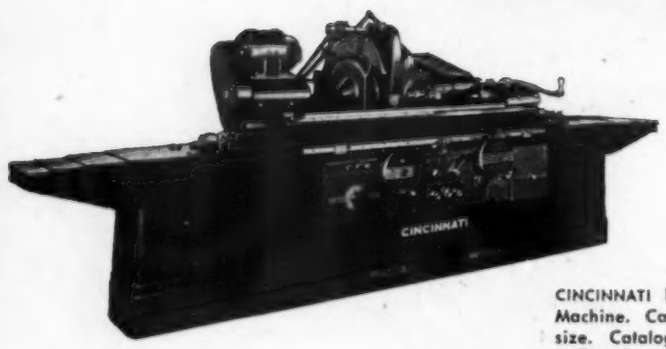
Photos Courtesy Sidney Machine Tool Co.

Fellows

ALL OPERATIONS FROM BLANK TO FINISHED GEAR

Left-Handed

CINCINNATI FILMATIC



CINCINNATI FILMATIC 10" Plain Hydraulic Grinding Machine, with angular wheelhead, transposed headstock and footstock, and extended cross traverse, developed for grinding parts of the type illustrated in the drawing on the opposite page.

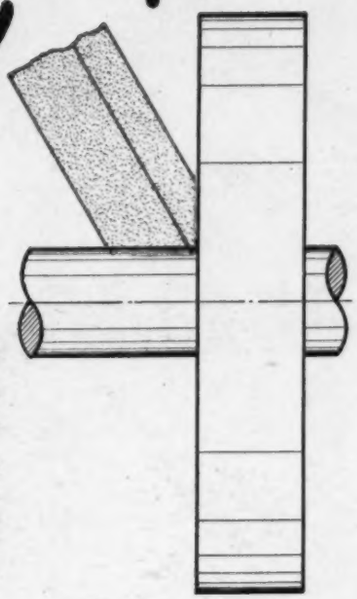
CINCINNATI FILMATIC 10" Plain Hydraulic Grinding Machine. Catalog G-490-2. Also available in 14"L size. Catalog G-533-1. Between-center lengths 18", 36", 48", 72" and 96".

CINCINNATI GRINDERS

CENTER TYPE GRINDING MACHINES

GRINDER — brightens up a long face!

• It's no trick to grind the diameter and the face of an adjoining flange when there's not much difference in size, but when the ratio increases to four or five, then additional problems must be overcome. The machine illustrated here—a semi-standard CINCINNATI FILMATIC Angular Wheelhead Grinder—grinds the body diameter of the part, and at the same setting, the face of an adjoining flange up to 16" diameter. Starting with a stripped down CINCINNATI FILMATIC 10" Plain Hydraulic Grinder, Cincinnati Application Engineers added the following units: right-hand headstock raised to swing 16" diameter; left-hand raised footstock with latch type retraction of center; 30° angular wheelhead raised to grind 16" diameter work; 5" hydraulic cross traverse at a grinding rate. The machine handled the job perfectly, accurately sizing the stem diameter while producing a high-grade finish on the face of the flange at the same setting. ¶Perhaps you could use this type of equipment to advantage for some of your cylindrical grinding operations. Why not talk it over with our Application Engineers?



Drawing of the part and the wheel, showing how CINCINNATI FILMATIC 10" Plain Hydraulic Grinder with angular wheelhead produces a high-grade finish on both the stem and the face of the flange, in one setting.

CINCINNATI

See the CINCINNATI GRINDERS DISPLAY at the MACHINE TOOL SHOW, Chicago, Sept. 17-26

INCORPORATED CINCINNATI 9, OHIO, U. S. A.

CENTERLESS GRINDING MACHINES • CENTERLESS LAPPING MACHINES

Van Norman

RAM TYPE MILLING MACHINES

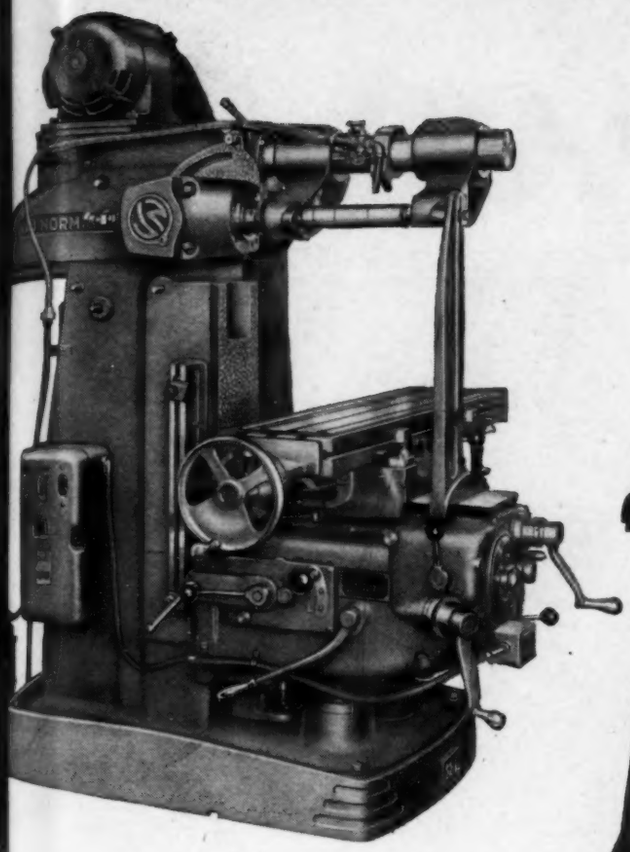
Handle Most Milling Jobs without Attachments

Do your milling requirements vary from job to job, day to day? Van Norman Ram Type Millers will solve your problem by permitting you to perform conventional horizontal or vertical as well as angular milling *all* on *one* machine. All you have to do is swivel the adjustable cutterhead to the required type of milling, set up the work and you're set to do the job.

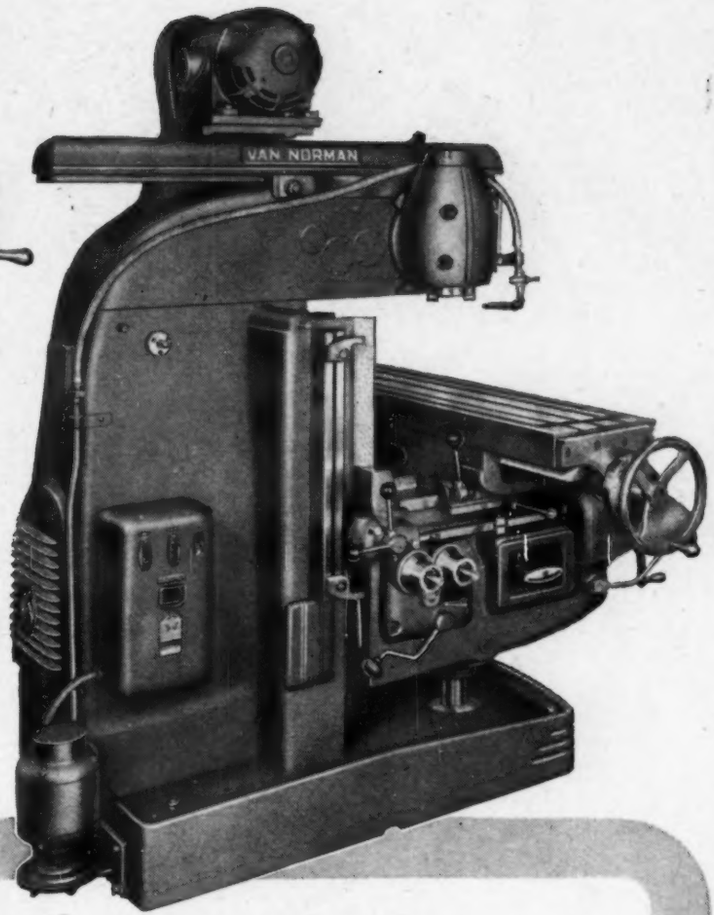
In addition, these versatile millers save you time and increase production by minimizing work reset-up because you swivel the cutterhead instead of changing the set-up.

Van Norman Ram Type Millers enable you to meet all milling jobs and cut costs in the tool room, machine shop, experimental laboratory, tool and die shop and pattern shop. They are available in 16 models. Write for complete details and catalogue describing these machines today.

"IT PAYS TO VAN NORMANIZE"



No. 22L
Head Horizontal



No. 26
Head Vertical

VAN NORMAN RAM TYPE MILLERS

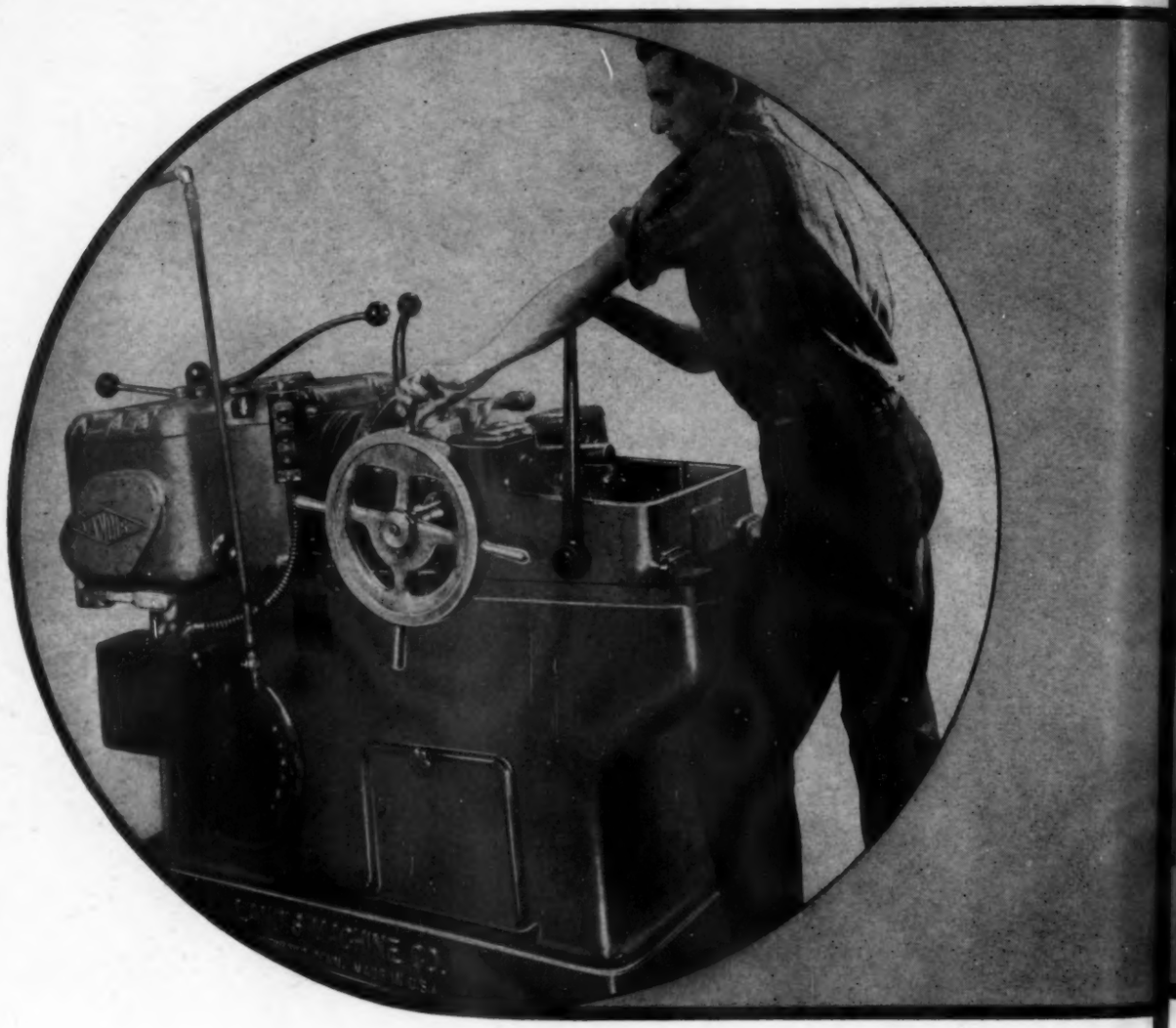
No. 36	Table:	58 x 13 in.	No. 22M	Table:	50 x 10 in.
No. 26	Table:	50 x 12 in.	No. 12	Table:	32½ x 9⁵⁄₁₆ in.
No. 22L	Table:	45 x 10 in.	No. 6	Table:	26¾ x 6⅞ in.

Van Norman Ram Type Models are made with plain or universal saddles.

These millers come in numerous special models which have a higher column providing greater distance between center of spindle and top of table. The machines are especially useful in applications encountered in pattern and die work which require a greater vertical range than available in standard models.

VAN NORMAN COMPANY
SPRINGFIELD 7, MASSACHUSETTS

LANDMACO *Pipe*



. . . . *threads, reams, and*

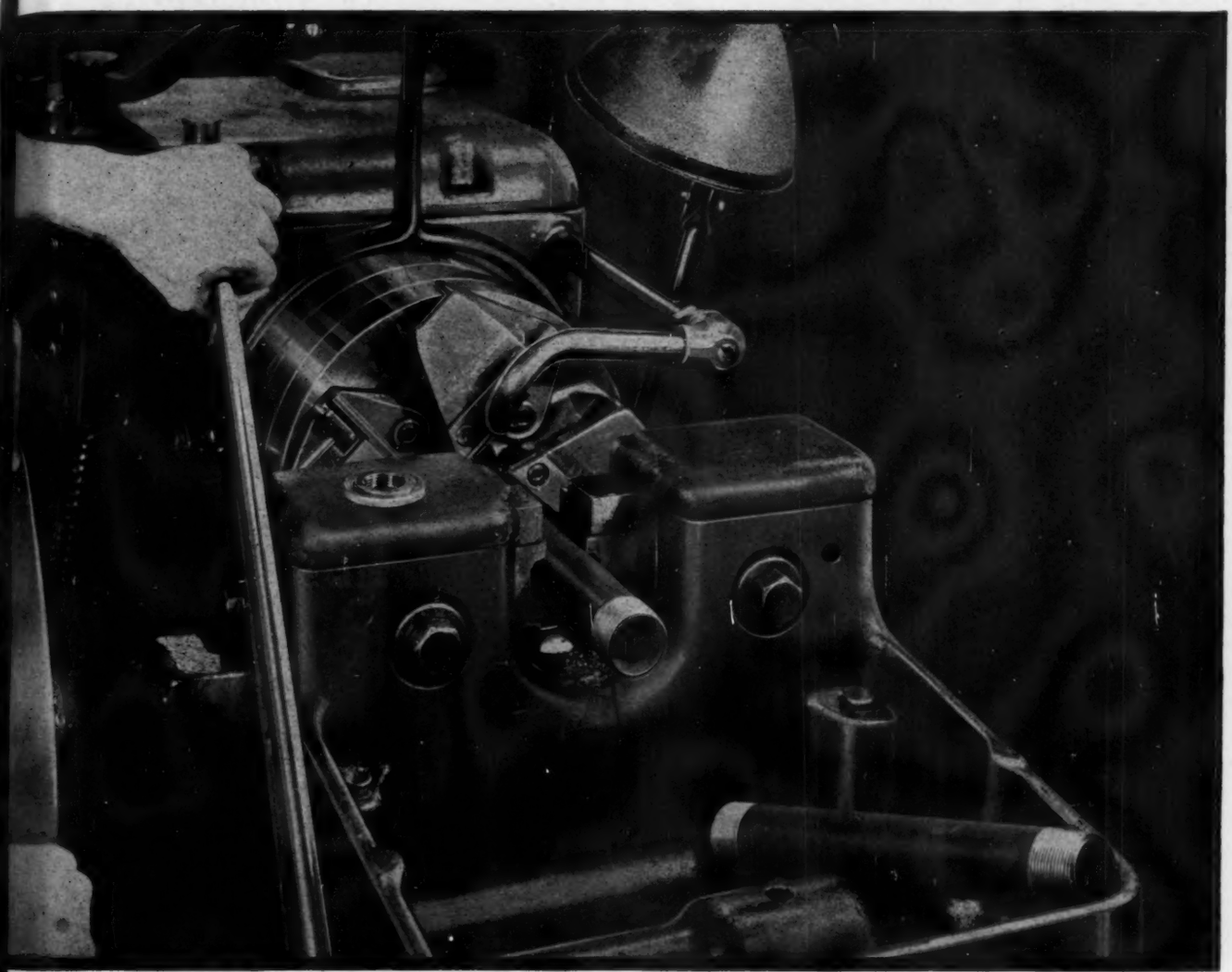
The Landmaco Single Head Pipe and Nipple Threading Machines, equipped with the Lanco Semi-Receding Internally Tripped Pipe and Nipple Die Head, is illustrated producing 1¼" diameter tapered pipe threads on blank steel pipe. The machine is being operated at approximately 63 R.P.M., and is producing nipples at the rate of 112 an hour.

LANDIS
REG. U.S. TRADE ~ MARK PAT. OFF.

FOR FURTHER DETAILS WRITE

LANDIS MACHINE CO

and Nipple THREADING MACHINE

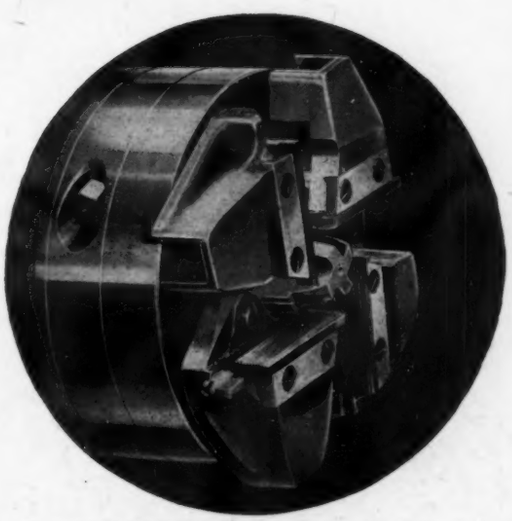


chamfers . . . . in one operation

The nipples are reamed, chamfered, and threaded in the same operation. The INTernal-Trip mechanism of the Die Head insures a uniform length of thread. While being used in the illustration to produce special length nipples for the company's own use, the LANDMACO is a high production hand-operated tool of thoroughly modern design. It is built in both single and double head models, in 1¼" and 2" sizes.

FOR BULLETINS D-67 & D-84

WAYNESBORO PENNA · U · S · A

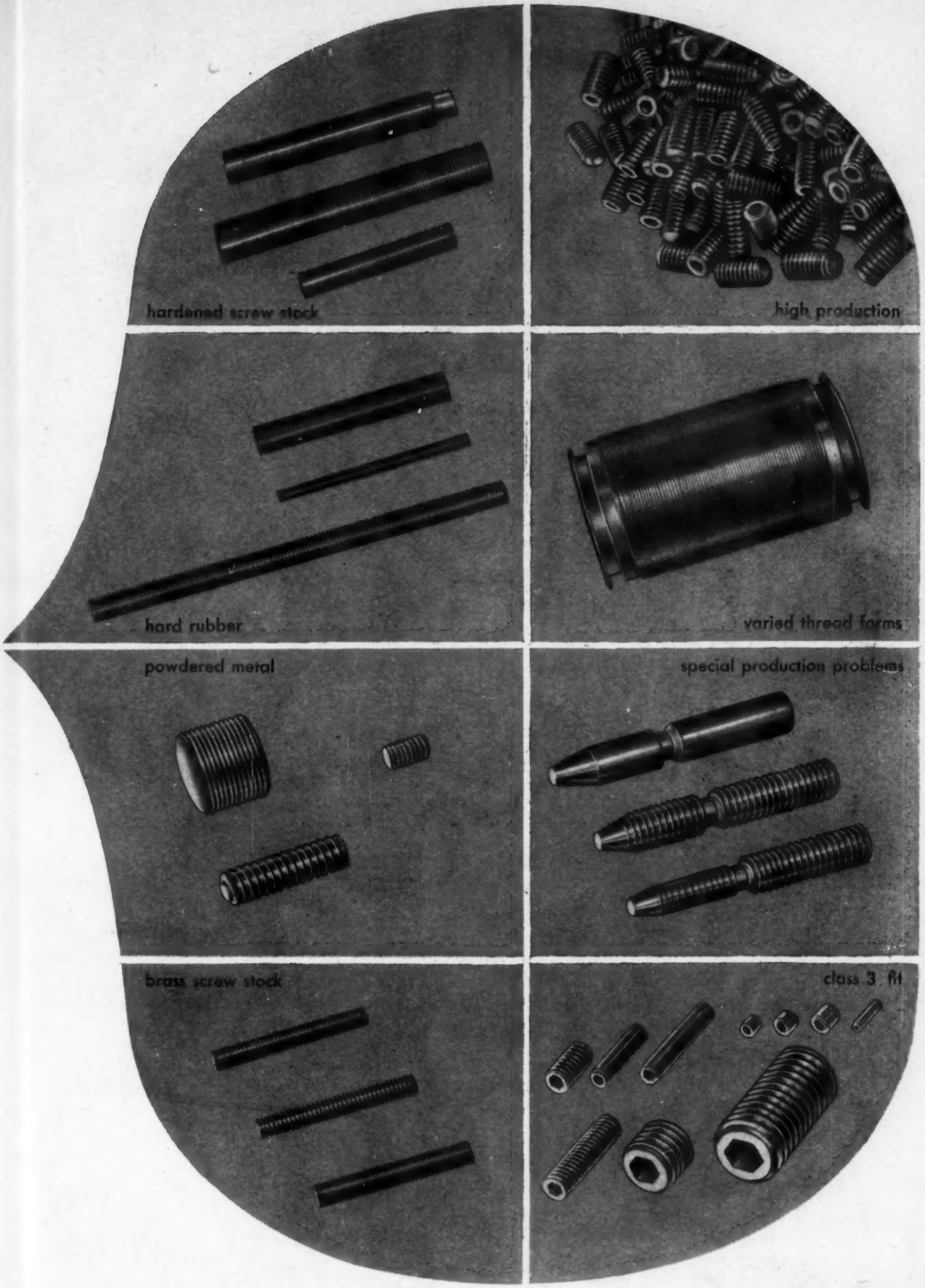


LANCO SEMI-RECEDING INTERNAL TRIP PIPE AND NIPPLE DIE HEAD

LANDIS TOOL centerless thread grinder

solves varied thread grinding problems

LANDIS TOOL
Precision Grinders



LANDIS TOOL COMPANY, WAYNESBORO, PENNA.

MONDAY MORNING ODOR

getting your Operators down?

SWITCH to Cimcool, and you and your workers can breathe freely. For this revolutionary new kind of cutting fluid helps keep air clean in three definite ways: **1.** Cimcool is a *chemical emulsion,* and therefore is not subject to rancidity even in the hottest weather. **2.** Cimcool can't burn or smoke. **3.** Cimcool produces no objectionable odors. No wonder that wherever it's used, operators swear by it.

and HERE'S THE REST OF THE STORY

- Faster cooling allows faster cutting.
- Uniform work temperature increases accuracy.
- No fire hazard—No slippery film.
- No chromates or other skin irritants.
- Contains long-lasting rust inhibitor.
- Chemical lubricity increases tool life.
- Covers 85% of all metal working jobs.

CIMCOOL

THE MULTI-PURPOS CUTTING FLUI

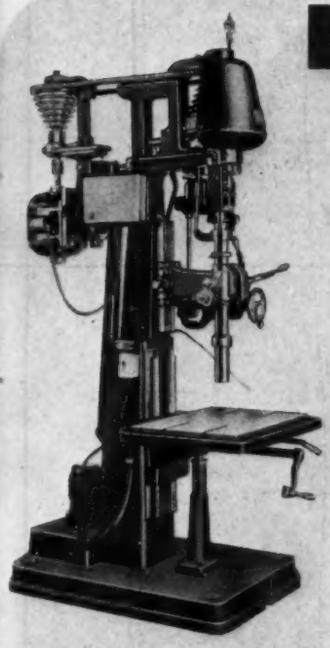
Trade Mark Reg. U. S. Pat. Off.

CIMCOOL DIVISION of THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO, U. S. A.

C-O means GO!

For speedy, precision performance — it's C-O from the word, "GO"! Forty nine years experience in designing and producing drill presses is your assurance of advanced design, sound engineering, quality construction. Write today for insert No. 90 illustrating the World's Most Complete Drill Press Line.

CANEDY-OTTO MEANS SPEEDY PRECISION PRODUCTION



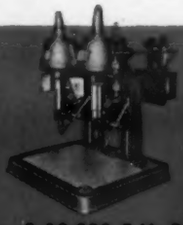
21" BOX COLUMN FLOOR DRILL

1-½" capacity sliding head drill available in 1-, 2-, 3-, 4- and 6-spindle models, of full ball and Timken roller bearing design. Eight step Vee belt drive on famous C-O tilting motor bracket gives sixteen spindle speeds. Positive geared power feed. Automatic stop. Also operates through lever, power feed or worm wheel feed. Accurately machined column, base an adjustable table.

21" STATIONARY HEAD FLOOR DRILL

Eight speed, 1-½" capacity, semi-cast one piece steel construction with lower column turned and ground. Equipped with back gears and power feed, ratchet type lever feed, wheel feed and automatic stop. Semi-cast steel table and base, well ribbed, T-slotted, accurately machined. Table revolves on column. Available with either tight or loose pulley drive for power take off, electric Vee belt, or geared motor drive.

16" six speed sensitive Royal Bench Drill in ⅜"-⅞"-1" capacity. Available in floor and bench models one through six spindles.



16" six speed No. 3000 S.V. four spindle bench drill, ⅜"-¾" capacity, in bench and floor models one through six spindles.

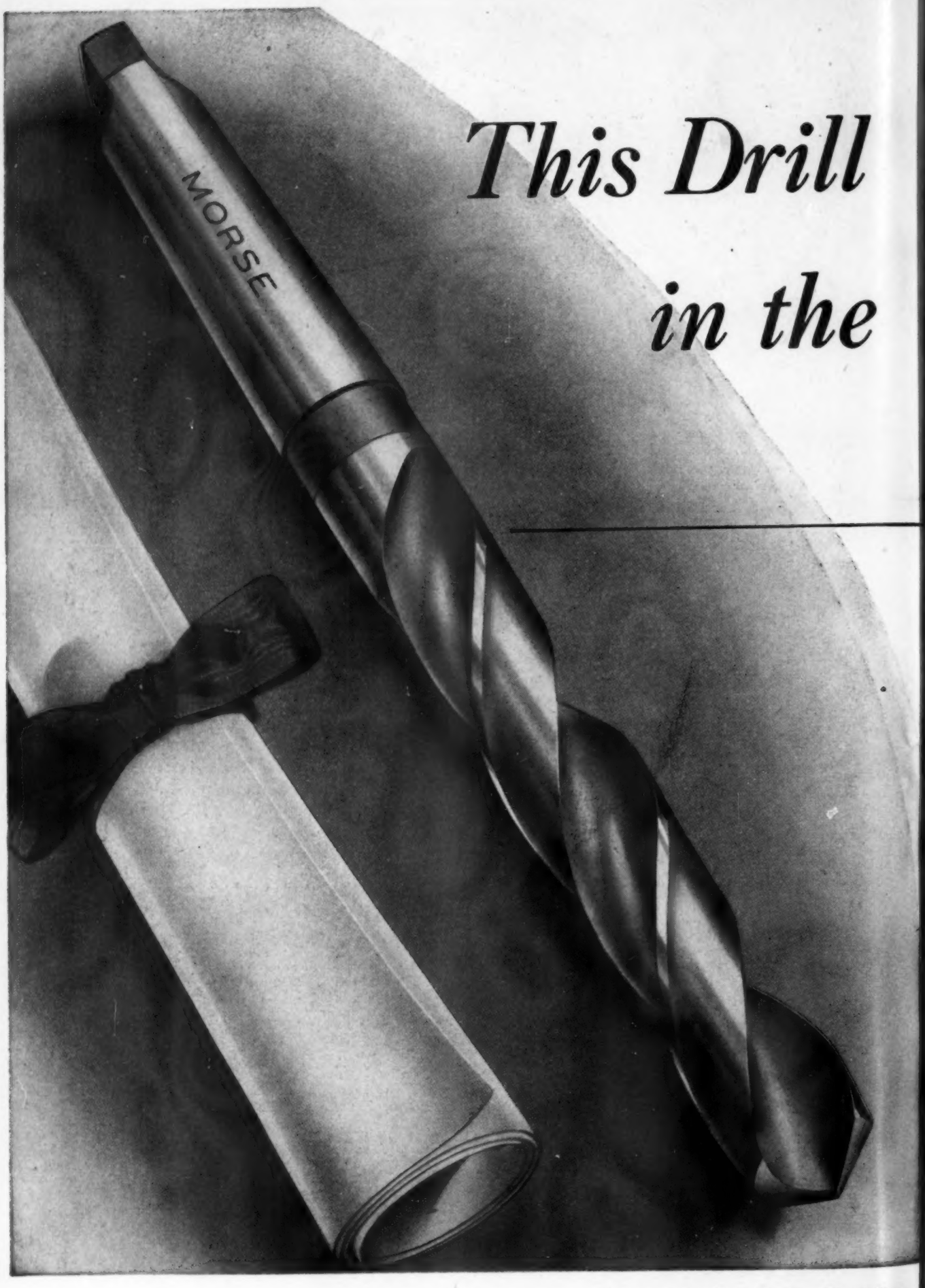
16" six speed No. S-10,000 S.V. Bench Drill, 5/16"-⅝" capacity. Available in floor and bench models one through six spindles.

C-O THE WORLD OVER

CANEDY-OTTO MFG. COMPANY

Chicago Heights, Illinois

Builders of the World's Most Complete Drill Press Line — radial drills, sensitive drills, upright drills, hi-speed drills and special drilling machinery.



This Drill in the

Graduated with Honors "College of Hard Knocks"!

MORSE FORGED TAPER SHANK DRILL
Forged for Toughness—
Milled and Ground to Morse Precision Standards

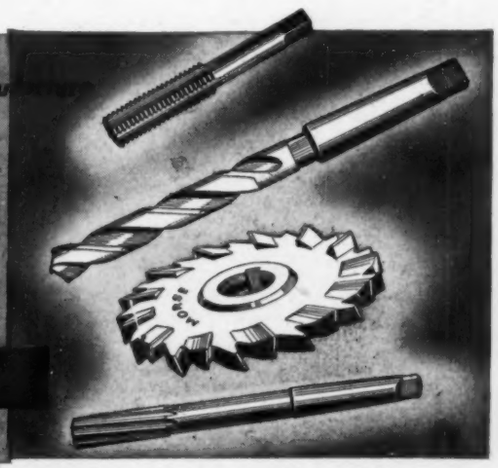
Here's a drill that offers a "liberal education" in serviceability and cutting efficiency. It's forged for strength and toughness, then milled and ground to the precision accuracy that's typical of all Morse tools. In addition, the *helix angle* selected for this drill is the result of long study to obtain greatest efficiency for cutting operations. All these features *combined* provide you with an all-purpose drill that will earn its keep many times over—whether drilling gear forgings, connecting rods, crankshafts, cast iron, chrome nickel steels, etc. Buy this drill—it'll fill your bill! Your Industrial Supply Distributor can supply you.

Accuracy, Quality, Uniformity: the MORSE Code of Cutting-Tool Manu

MORSE TWIST DRILL & MACHINE COMPANY

The Original Manufacturer of Twist Drills

NEW BEDFORD, MASSACHUSETTS



York Store: 130 Lafayette St. • Detroit Store: 2952 East Grand Blvd. • Chicago Store: 570 West Randolph St. • San Francisco Store: 1180 Folsom St.

For HEAVIER FEEDS at HIGHER SPEEDS

Always specify

CLE-FORGE HIGH SPEED DRILLS

TRADE MARK REG. U.S. PAT. OFF.

Drilling a single hole in a forged brake lever, as shown in the photo, is not a difficult operation. Yet even in this case, *cost per hole* has been the determining factor in selecting the proper drill for the job. ◈ On this basis you will find that CLE-FORGE High Speed Drills give you maximum results at minimum cost. Because these drills consistently take heavier feeds at higher speeds, they produce holes at lower cost.

Telephone your

I S D

INDUSTRIAL SUPPLY DISTRIBUTOR

The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49TH STREET
CLEVELAND 14

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

CLEVELAND DISTRIBUTORS EVERYWHERE ARE READY TO SERVE YOU

101 THOMAS ST., NEW YORK 7 • 9 NORTH JEFFERSON ST., CHICAGO 6 • 608 HOWARD ST., SAN FRANCISCO 5
2929 EAST GRAND BLVD., DETROIT 2 • 1902 NORTH FIELD ST., DALLAS 2
E. P. BARRUS, LTD., LONDON W. 3, ENGLAND

Another Special Machine by Cross

Stated simply, today's most important production demand is for MORE THINGS FOR LESS MONEY. You will meet this requirement quicker and achieve more profitable results by using Cross machine tools.

Our ability to create special machine tools to do a combination of operations, or a single operation, will help you to produce more at *lower cost per piece.*

A recent example of this is the Three-Station, Power Indexed Milling Machine shown above.

PART: **Exhaust Manifold**

OPERATION: **Finish mill exhaust pipe flange and hot spot pad; both at the same time**

PRODUCTION: **110 complete parts (220 surfaces) hourly with an unskilled operator**

The exhaust pipe flange surface is milled at the first station (left) using an angular downward feed movement. At the same time the hot spot pad (right) is being milled at the second station—using a box type directional feed movement; down, across, up and back. While milling is going on at these two stations, the attendant simply unloads and loads at his station.

Investigate Cross Transfer-matics—the newest machine tool development for continuous automatic production.

THE CROSS COMPANY

Established 1898

©1947—THE CROSS COMPANY

SPECIAL MACHINE TOOLS

DETROIT 7, MICHIGAN

MILLING • DRILLING • TAPPING • BORING • TURNING • SHAPING • GRINDING • HONING

MAKE 1947 PRODUCTS ON 1947 PRESSES

Speed, power, streamlining, are the features that distinguish modern automobiles . . . and modern presses.

Put the same efficiency into your production line that is engineered into your products . . . Designed for maximum utility, Danly presses have the mechanical accuracy and rugged construction that make for faster runs, more accurate stampings, longer die life, less downtime, and *greater production.* Enclosed construction saves floor space, lessens safety hazards—especially in rows or batteries.

Bring your production equipment in step with the products you manufacture. *Make 1947 Products on 1947 Presses.*

STEEL UNIT FRAMES

Danly Open Back Inclinable and Horning presses have unit frames of rugged one-piece all-steel construction. The frames, massive for presses of this type and size, lend great rigidity and resistance to deflection to these presses. Gears and driving members completely enclosed within the frame run in a spray of filtered oil.

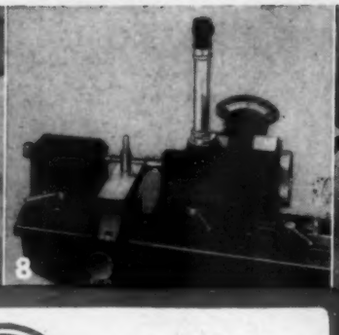
Unusually long gibbing and two slide connections make for even pressure along the full length of the stroke—insure accurate alignment on large or progressive dies—prevent eventual loosening up or slide play due to uneven loads.

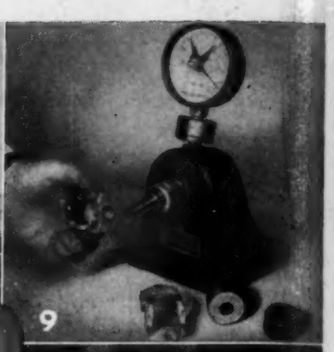
Danly O.B.I. and Horning presses range from 50 to 200 tons pressure in both single and two-point models.

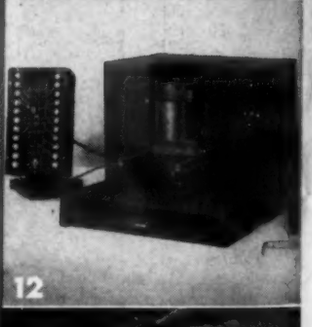
DANLY
The Press for Modern Production

These double geared presses are typical of Danly's complete line of one, two and four point straight-side presses. Pressures range from 100 tons up. Special sizes and types engineered to specifications.

DANLY MACHINE SPECIALTIES, INC.
2100 South 52nd Avenue
Chicago 50, Illinois







PRECISION AT WORK

Pictures like these are repeated thousands of times daily in the plants where the drive for a strong, competitive position has been spearheaded by a thorough-going gaging checkup. For alert management knows that manufacturing survival depends upon higher quality and lower cost — rising labor and material costs notwithstanding.

The new manufacturing science known as *Quality Control* is under intensive study in many plants, in full operation in others. P&W Comparators meet Quality Control requirements admirably.

There are P&W Gages for every purpose. Only a few are illustrated:

INDEX TO PICTURED GAGES

1 "Pilot" Cylindrical Plug Gages
2 Thread Plug Gages
3 Cylindrical Ring Gages
4 Thread Ring Gages
5 Electrolimit Height Gages
6 Electrolimit External Comparators
7 Supermicrometers
8 Standard Measuring Machines
9 Air-O-Limit Comparators
10 Adjustable Limit Snap Gages
11 Roll Thread Snap Gages
12 Multiple Electric Contact Gages
13 U.S.A. (Rectangular) Precision Gage Blocks
14 Hoke Precision Gage Blocks

The gages you need for modern competition are in the Pratt & Whitney line. Call in your P&W Engineer for a thorough study of your gaging problems and ask us for detailed literature.

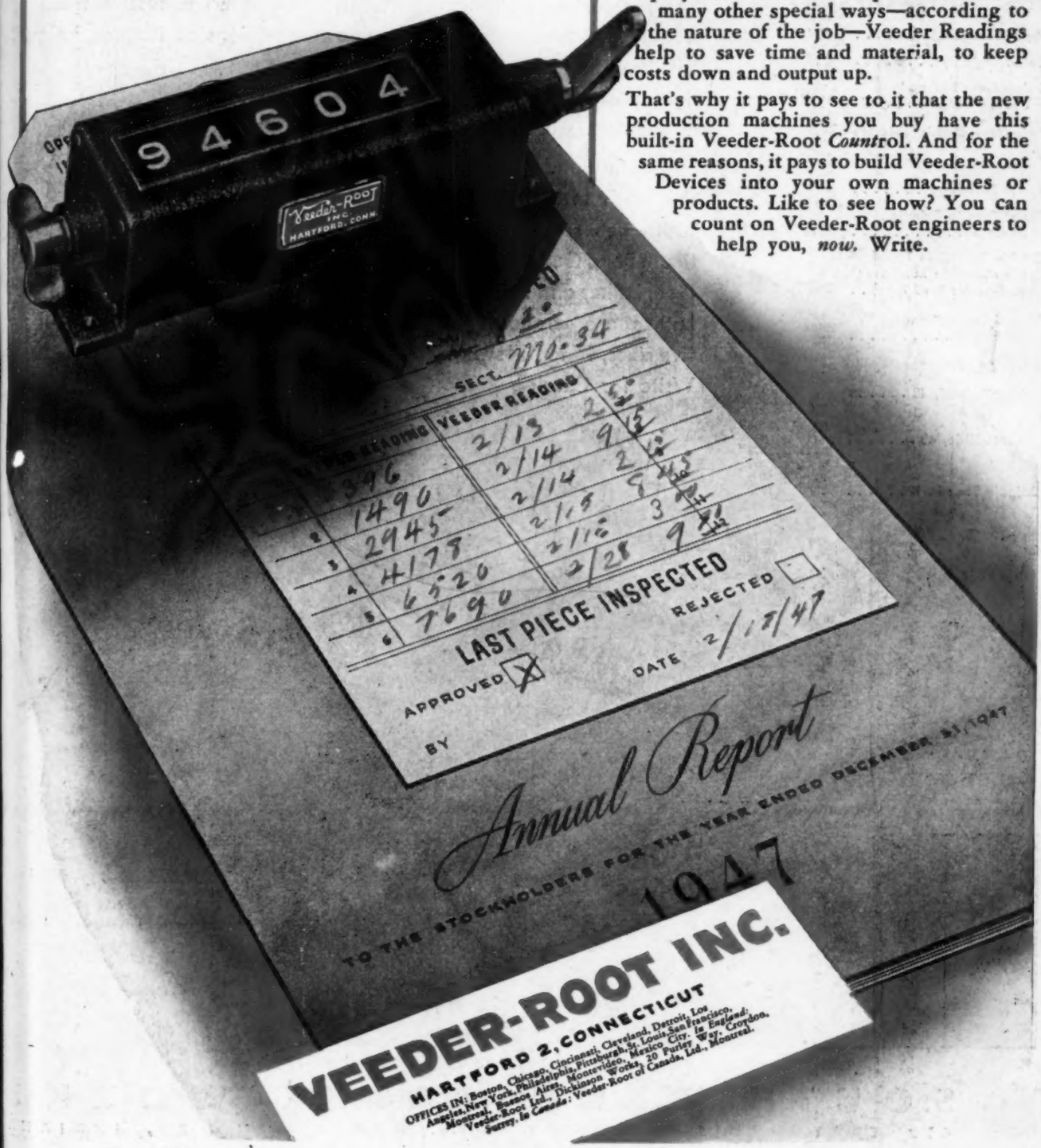
PRATT & WHITNEY

Division NILES-BEMENT-POND COMPANY

West Hartford 1, Connecticut

Veeder-Readings

will make for
BETTER READING
on your next Annual Report



*VEEDER READING is a standard term used by manufacturers to designate the performance figures which keep turning up on the faces of Veeder-Root Counting Devices built into—or installed on—any type of production machine or process.

These Veeder Readings are *direct* readings. Operators don't have to convert or translate them . . . which means far fewer errors. What's more, these readings indicate any mechanical slowdown, so that it can be corrected immediately . . . before final assembly bogs down, and inter-departmental timing is thrown off. These readings simplify the work of inspectors. And in many other special ways—according to the nature of the job—Veeder Readings help to save time and material, to keep costs down and output up.

That's why it pays to see to it that the new production machines you buy have this built-in Veeder-Root *Count*rol. And for the same reasons, it pays to build Veeder-Root Devices into your own machines or products. Like to see how? You can count on Veeder-Root engineers to help you, *now*. Write.

Speed 2nd Operation Work

SOUTH BEND
PRECISION TURRET LATHES

South Bend Precision Turret Lathes are specifically designed for the quantity production of small parts. The turret head is so constructed that it will index within plus or minus .0005", measured 4" from turret face. Fast and easy to handle, these lathes give full freedom to the operator's producing power. There is no excessive mass or weight in moving parts to slow down operations and cause fatigue. Yet, South Bend Turret Lathes have the rigidity and power for rapid production on all work within their capacity.

South Bend Precision Turret Lathes are made in two sizes: series 900 and 1000—see specifications. South Bend Quick Change Gear Lathes and Toolroom Lathes are available in five sizes, 9" to 16" swing. Write for Catalog 100-F.

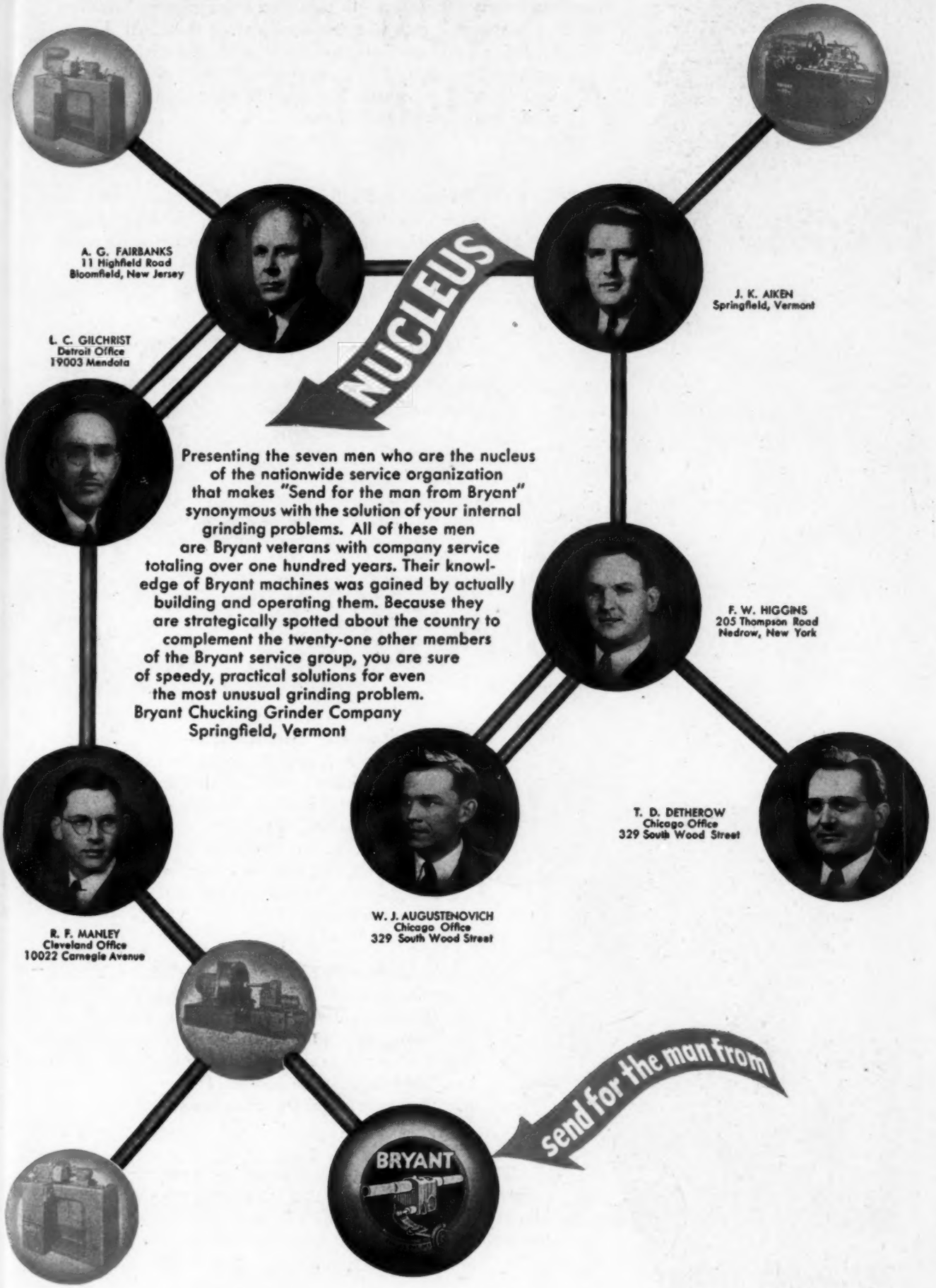
SPECIFICATIONS •

	SERIES 900	SERIES 1000
Hole Through Spindle	¾"	1⅜"
Collet Capacity	½"	1"
Swing Over Bed and Saddle Wings	9¼"	10⅛"
Swing Over Double Tool Slide	3 9/16"	3 9/16"
Swing Over Compound Slide	5½"	5⅞"
Turret Tool Feed	4"	4"
Turret Face to Spindle Distance	20⅜"	19⅜"
Double Tool Slide Travel (Combination handlever and power feed type)	3⅝"	3⅜"
Thread Cutting Range, 48 threads	4 to 224	4 to 224
Carriage Power Feeds:		
Longitudinal, 48	.0015" to .0853"	.0015" to .0836"
Cross-Slide, 48	.0004" to .0252"	.0006" to .0309"
Spindle Speeds, 12	41 to 1270	50 to 1357

Series 1000 Turret Lathe
—prices start at
$1147.00
f. o. b. factory, less electrical equipment.

BUILDING BETTER LATHES SINCE 1906

SOUTH BEND LATHE WORKS
419 EAST MADISON STREET • • SOUTH BEND 22, INDIANA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Presenting the seven men who are the nucleus of the nationwide service organization that makes "Send for the man from Bryant" synonymous with the solution of your internal grinding problems. All of these men are Bryant veterans with company service totaling over one hundred years. Their knowledge of Bryant machines was gained by actually building and operating them. Because they are strategically spotted about the country to complement the twenty-one other members of the Bryant service group, you are sure of speedy, practical solutions for even the most unusual grinding problem.
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329 South Wood Street
R. F. MANLEY
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10022 Carnegie Avenue
BRYANT
send for the man from

6 Good Reasons Why LANDIS TOOL

1

Freedom From Vibration—Unbalanced or improperly balanced rotating parts can cause vibration and marred finish. All Landis Tool rotating parts are balanced on a machine which tells the amount and location of any unbalance. Perfect static and dynamic balance is assured because the correction is properly made and vibration eliminated.

2

Heat Seasoned Castings—Annealing of cast parts in a furnace with slow cooling seasons all Landis Tool castings. This eliminates any casting strains that could cause dimensional change during the usual slow aging of castings after a machine was placed in service.

3

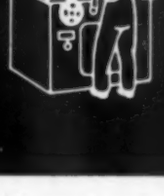
Microsphere Wheel Spindle Bearings—This exclusive Landis Tool development permits the wheel spindle to run true and smooth. The spherical shape makes the bearing self-aligning under all load conditions. The babbitt lined steel bearing is split. This permits use of a method whereby bearing clearance can be set exactly and a calibrated setting adjusted later to compensate for wear. This eliminates any possibility of chatter marks on the work due to spindle vibration.

4

Automatic Wheel Feed—Dimensional accuracy and smoothness of operation are assured by the hydraulic operation of the automatic wheel feed. Cushioning valves at each end of the wheel feed cycle prevent jarring or vibration. An automatic compensating device balances any changes in oil viscosity and makes operation independent of change in oil temperature.

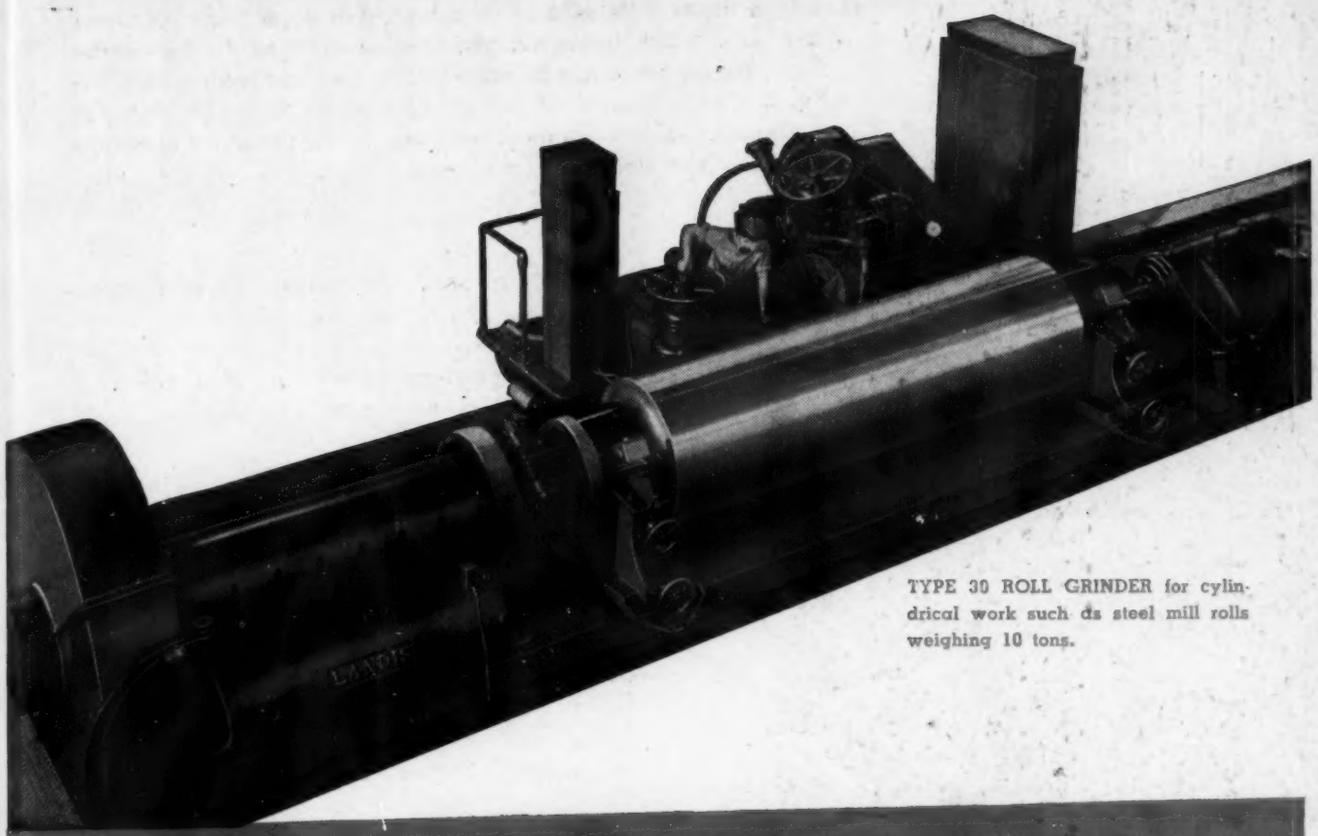
5

Hydraulic Table Traverse—The work table is traversed smoothly by hydraulic power. Speed is adjustable from 3″ per minute to 360″ per minute. Reversing is shockless and accurate with cushioning valves and sensitive reversing mechanism. Tarry time before reversal is also adjustable to grind the work to size and clear itself for the new cut.



6

Factory Tested—After assembly every machine is given an operating test. It is set up and run just as it will be in your shop. This gives a final double check and 100% inspection of all machines before shipment.



TYPE 30 ROLL GRINDER for cylindrical work such as steel mill rolls weighing 10 tons.

Precision Grinders

produce to close tolerances with fine finishes

Whether you are grinding parts for watches or steel mill rolls, you will find that Landis Tool Precision Grinders will enable you to work to the closest tolerances with fine unmarred finishes. We have listed six of the many good reasons for these results. In addition, there are many high production features of Landis Tool Grinders that make them cost cutting tools.

If you have a precision grinding problem, we would like to show you what these "6 good reasons" can mean to you. 64

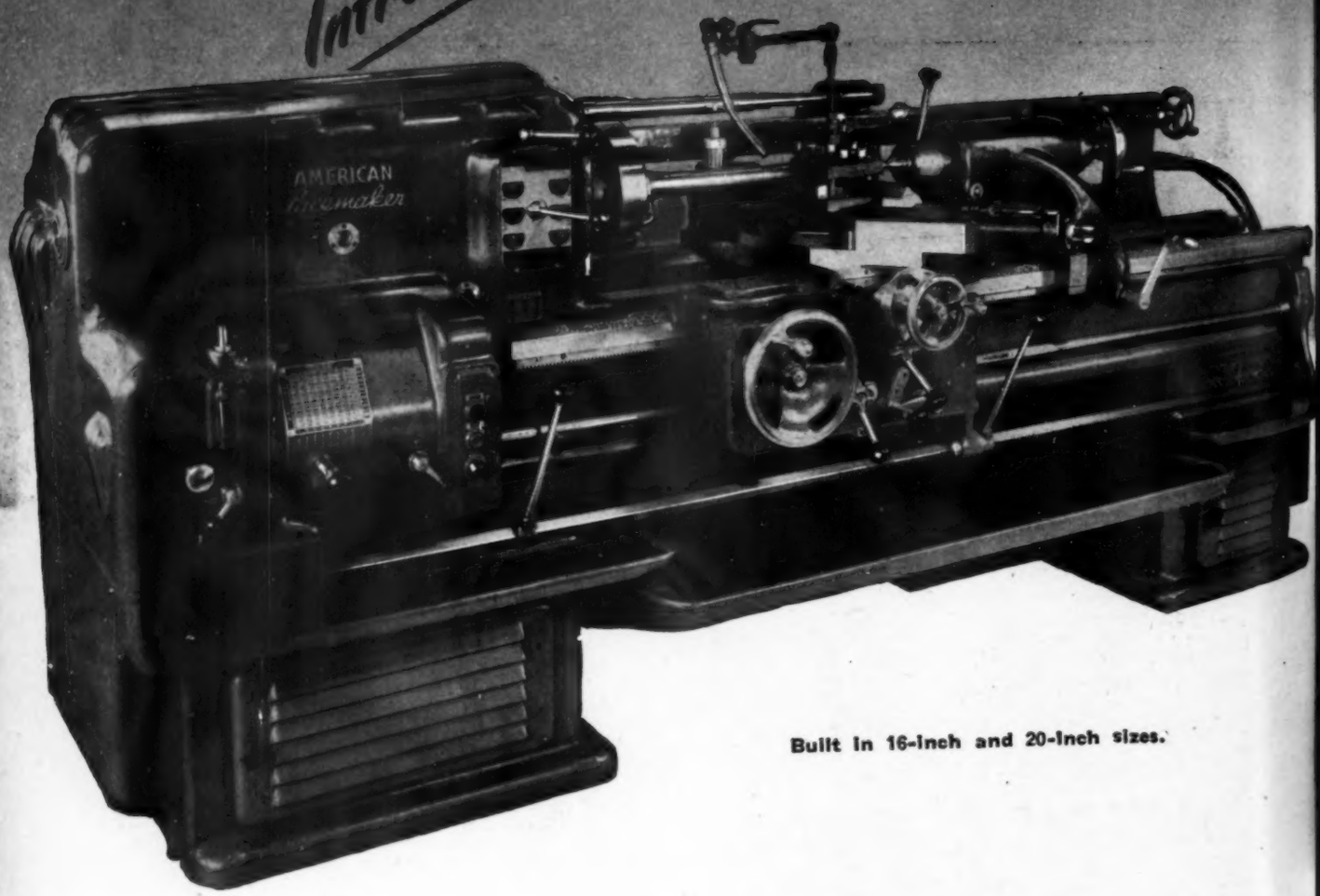
4" TYPE H PLAIN HYDRAULIC GRINDER for mass production of precision small parts.

LANDIS TOOL
Precision Grinders

LANDIS TOOL COMPANY, WAYNESBORO, PA.

"AMERICAN" HYDRAULIC SHAFT-DUPLICATOR

Introduces a new Turning Technique that



Built in 16-inch and 20-inch sizes.

THE AMERICAN TOOL WORKS CO.

1. Reproduces accurately from a template.
2. Reduces production costs.
3. Cuts set-up time to a fraction required by other methods.
4. Minimizes measuring and "miking".
5. Eliminates multiple tool set-ups.
6. Permits continuous cutting.
7. Is controlled by one hydraulic system.
8. Produces a "quality" finish frequently eliminating the necessity of grinding.

The new "American" "H S-D" (Hydraulic Shaft-Duplicating) Lathe is a thoroughly engineered development for reproducing work shapes from a template by means of a hydraulically controlled cutting tool. The template holder and tracer head are built in at the rear of the lathe where they will not obstruct the operator's vision of the work or interfere with loading and unloading. All operating controls are located at the front of the lathe.

It is faithful and accurate in its reproduction.

It will reproduce steps, tapers, right angle and tapered shoulders, recesses, grinding necks and radii and is especially adapted to the production of such work as spindles, motor shafts, valve stems, back shafts, piston rods, axles—in fact any shaft having an irregular contour.

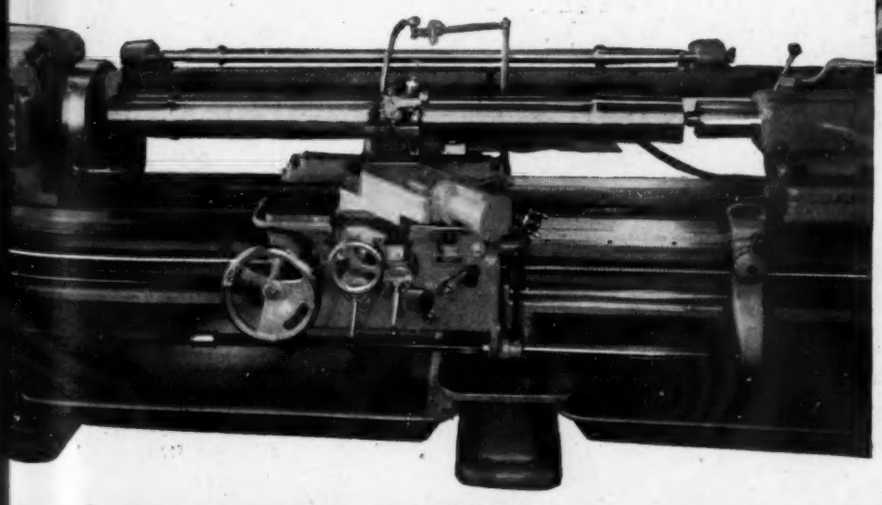
A single hydraulic system is employed for operating the hydraulic tracer valve and the piston which controls the movement of the tool slide carrying the cutting tool. This simplicity is an outstanding feature and insures accurate reproduction, freedom from failures and elimination of work rejects.

This new metal cutting technique permits continuous cutting without interruption for measuring or calipering at feeds and speeds to the cutting limit of Cemented Carbide tools. "Miking" is confined to the first diameter only after which all other diameters are secured automatically.

This machine may be quickly converted to standard lathe operations.

Descriptive Bulletin No. 35 sent upon request.

4¼" step shaft of SAE 4145 steel being machined complete in 18 minutes on 16-inch "American" "H S-D" Lathe.



Machining Locomotive Piston Rods, floor to floor, in 34 minutes on 20-inch "American" "H S-D" Lathe.

Lathes and Radial Drills Cincinnati, Ohio, U. S. A.

Here They Are In One Handy Box...

The 16 Most Popular Shapes and Sizes of Norton Mounted Points

HANDY to buy, handy to use, handy to keep—that's the Norton No. 16 Mounted Point Assortment. It's made up of one each of the sixteen sizes and shapes which Norton sales records show are most in demand. They're packaged in an ingenious box which brings them to you safely, serves as a handy holder while they are in use and a sturdy container when they are not.

The points are the same Norton product that's been so popular with tool makers for years. They are made of fast, cool cutting 38 ALUNDUM abrasive, vitrified bonded and strongly cemented on steel spindles.

Order one or more No. 16 Mounted Point Assortments from your Norton distributor.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

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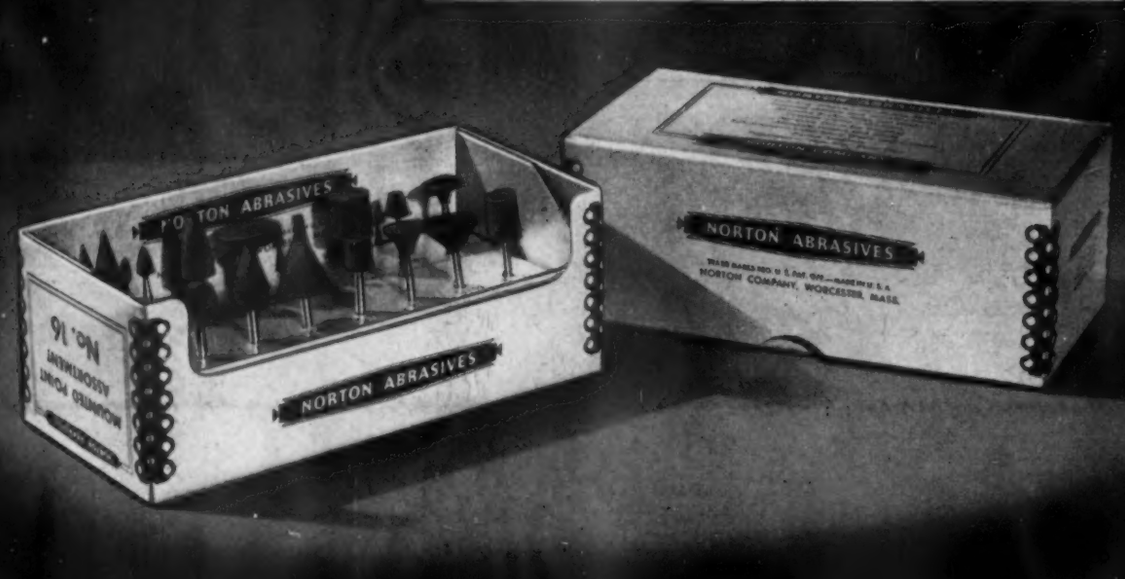


The CONE AUTOMATIC MACHINE COMPANY

sees many

GOOD THINGS AHEAD

It is reported that . . . . . .

The Boston and Maine Railroad is washing cars automatically at the rate of one a minute between revolving brushes with a water spray.

get ready with CONE for tomorrow

The sound-on-wire principle has been applied to a unit made by Sound Media to be used with billboards or displays.

be ready with CONE for today

Permanete Metals Corp. is experimenting with a magnesium blasting powder that is said to be insensitive to shock and not ignited by sparks.

get ready with CONE for tomorrow

The new Bendix-Stromberg carburetor compensates for changes in atmospheric pressure as in mountain driving.

be ready with CONE for today

Bendix Radio Division's new Type PAR-3 receiver weighs only one and a half pounds and is particularly suitable for small aircraft.

get ready with CONE for tomorrow

New York City's Third Avenue Transit Corporation is shifting from rail cars to buses and will use 700 General Motors 44-passenger diesel buses.

be ready with CONE for today

An electronic "stop watch" developed at Yale University is said to measure the speeds of particles accurately to a thousand millionth of a second.

get ready with CONE for tomorrow

Hudson Products Co. of Detroit makes a grinder with a 3-inch silicon-carbide grinding wheel driven by a water motor that can be attached to any faucet.

For crippled veterans, International Business Machines Corp. has devised an electrically operated artificial arm.

get ready with CONE for tomorrow

North American Phillip Co. is developing an arc welding technique that can be used by unskilled workers.

be ready with CONE for today

Aerojet Engineering Corp. predicts the use of its rocket power for the stopping and starting of heavy machinery.

get ready with CONE for tomorrow

The Bureau of Standards has a new gel capable of detecting one part in 500 million of CO.

The Whiting Corp. of Harvey, Illinois, has an electric hoist that will lift a ton but weighs only 87 pounds.

be ready with CONE for today

American Gas Accumulator Co. is making an inexpensive, breakable runway light for airports that shatters, if struck, without damaging the plane.

get ready with CONE for tomorrow

Dow Chemical Co. has used a solution of calcium chloride to freeze-proof carloads of coal in transit.

be ready with CONE for today

Diamond Instrument Co. is making a portable seismograph, particularly for highway surveys and constructions.

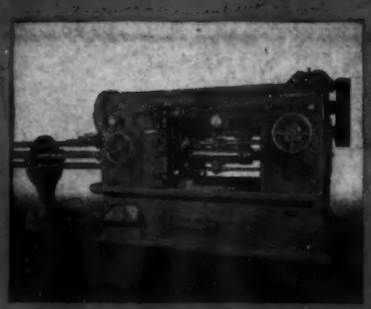
get ready with CONE for tomorrow

New Hampshire Ball Bearings Inc. is the first in this country to put the new ultra-small precision ball bearings into mass production.

FOLLOW THESE PAGES FOR NEWS OF PROGRESSIVE PRODUCTION

Give *ordinary* jobs to any automatic. Put the *special* ones on a CONE.

From 1¼" dia. SAE 1112, a 6-Spindle Conomatic, with 11 tools, produces the piece shown in 56 seconds.



Ask your CONE representative to show you our new color motion picture

CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U.S.A.

49

THIS IS DUPLITROL . . .

. . . FOR MAKING REPETITIVE PARTS *WITHOUT JIGS!*

2 ¾ x ¾ C.R.S. **BARS** *ONE* **HORIZONTAL** *ONE* **VERTICAL** . . . with ¼" holes machined at the desired spacing.

+ **2** **HARDENED PINS** . . . used to select locations according to the desired pattern of holes.

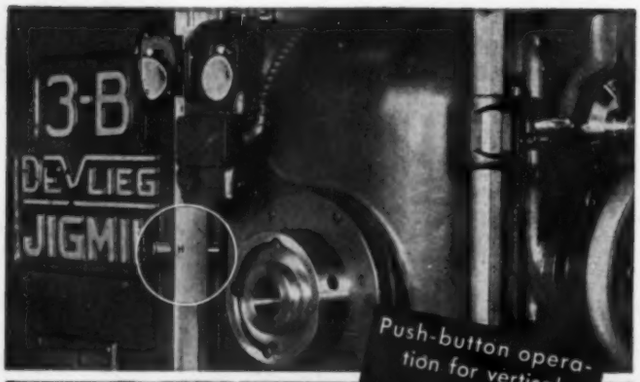
+ *Automatic* **POSITIONING** . . . accurately and dependably provides foolproof spacing for machining repetitive parts *without jigs.*

= DUPLITROL by DEVLIEG

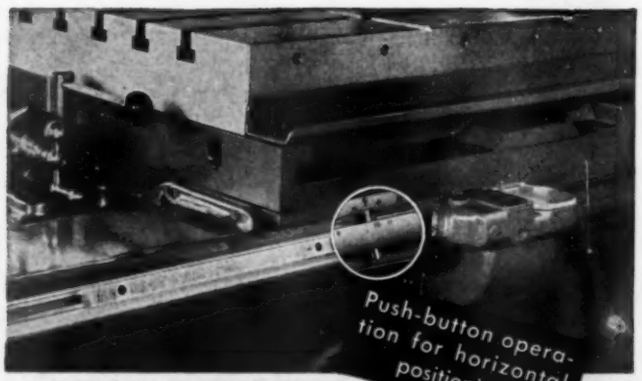
The finest known process for accurately spacing and machining holes.

THIS IS HOW IT WORKS . . .

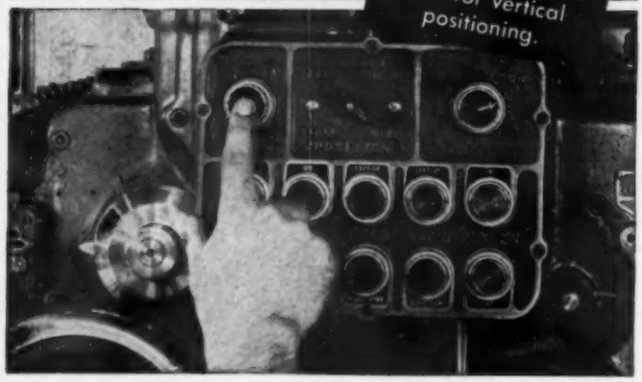
Illustrated at right is one vertical bar and one horizontal bar with pins used as masters on the 3B DeVlieg Duplitrol Equipped Jigmil. Below are illustrations showing how all spacing is done in response to push-button operation.

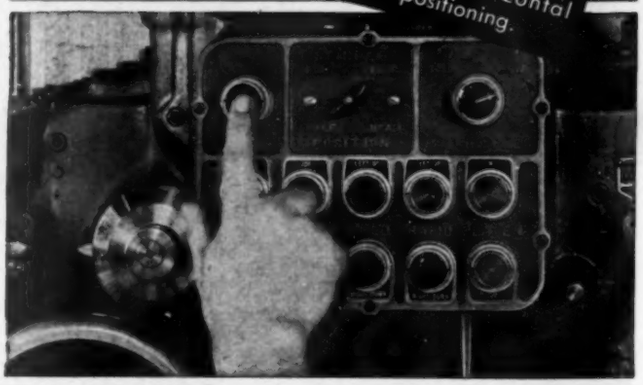


Push-button operation for vertical positioning.



Push-button operation for horizontal positioning.





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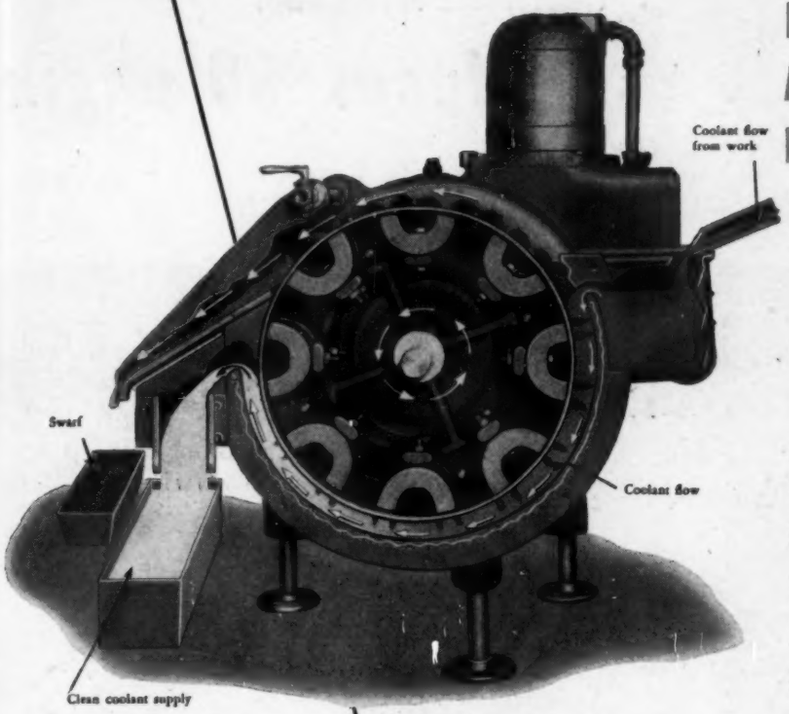
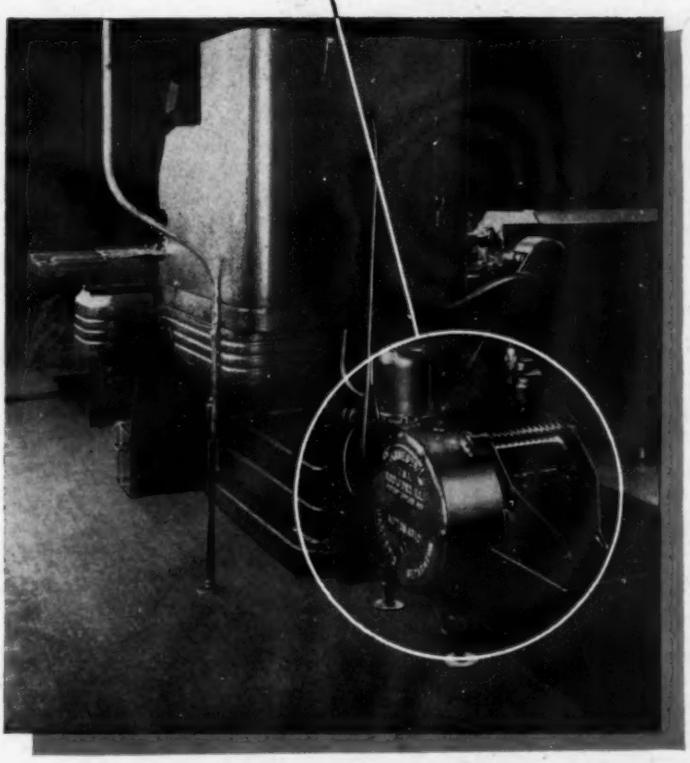
Why Not Try "A CLEAN SWEEP"-

IN REMOVING SLUDGE AND SEDIMENT FOR REDUCED DOWN-TIME?





BARNESDRIL

AUTOMATIC COOLANT SEPARATOR SAVES 22 HOURS MACHINE DOWN-TIME PER MONTH

Accumulated sludge and sediment accounted for 2 hours down-time every other day to clean out the machine on a high-production thread grinding operation. This manufacturer found that the installation of a BARNESDRIL Automatic Coolant Separator saved this valuable time for greater production, and resulted in the need for clean-out only once in six months continuous operation. As the coolant returns through the Separator, it flows between a shunt plate and the Magnetic Drum to which swarf, sludge and abrasive particles attach themselves. As the drum revolves these are "swept" out and deposited in a convenient waste disposal pan for easy removal.

On the basis of down-time saved alone, the production department estimates that this Separator has paid for itself in six months time. Equally important savings are found in production quality and tooling costs. The grinding wheel loads-up less frequently and requires fewer dressings. Finish on ground work is greatly improved. Clean coolant lines add to the operator's comfort. Coolant life is prolonged to normal structural breakdown.

The BARNESDRIL Automatic Coolant Separator is the easy, convenient, modern way to maintain high production metal cutting equipment with minimum costs. Ask your BARNESDRIL representative about the Magnetic-Automatic Coolant Separator today. Details on cost, capacity and ease of installation supplied without any obligation.

ADVANCE INFORMATION!

Write for a copy of the Magnetic-Automatic Coolant Separator bulletin. A copy will be mailed promptly. Ask for Bulletin B-1514.

BARNES DRILL CO.

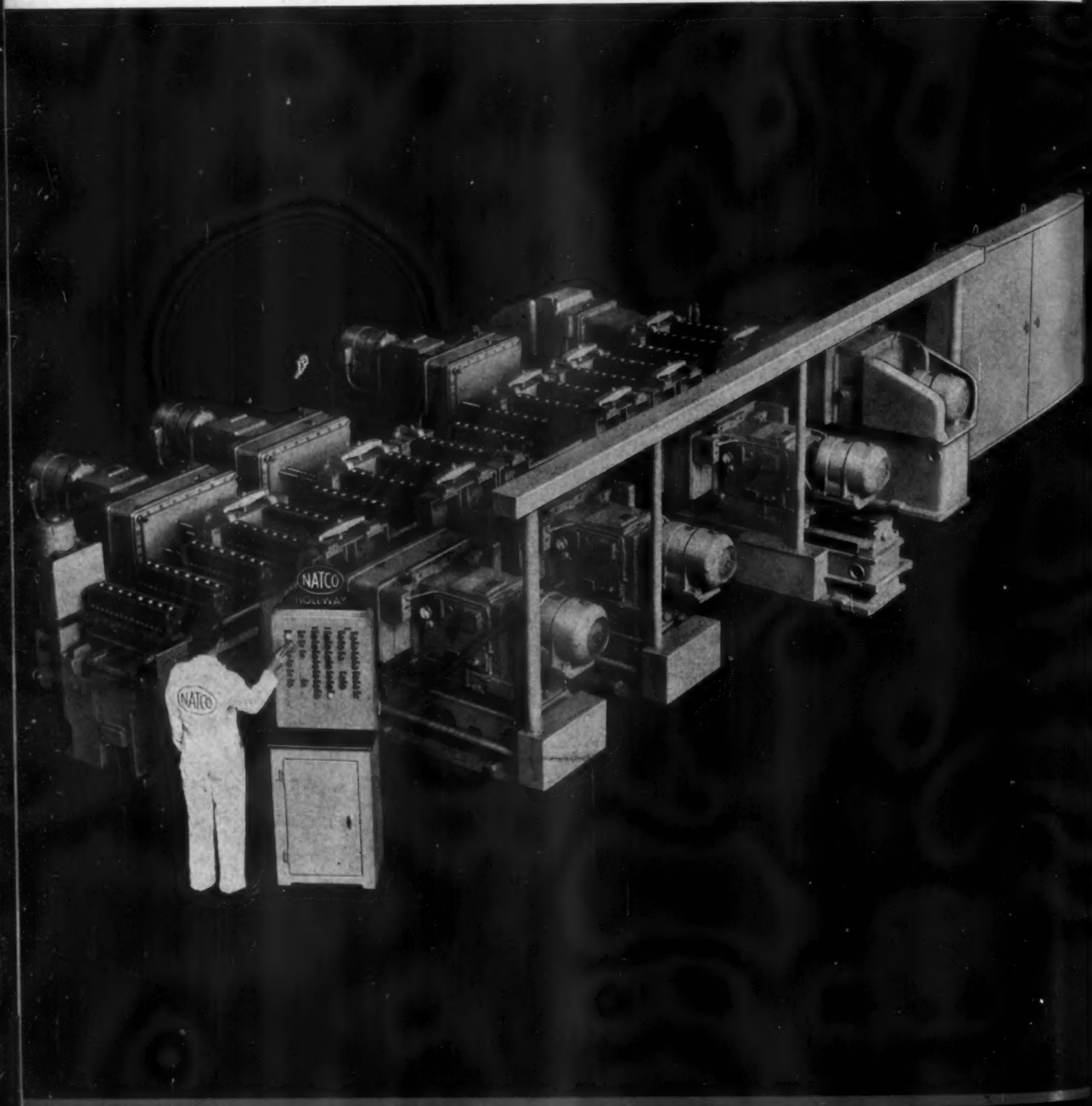
830 CHESTNUT STREET ROCKFORD, ILLINOIS U.S.A.

NATCO

HOLEWAY Processing

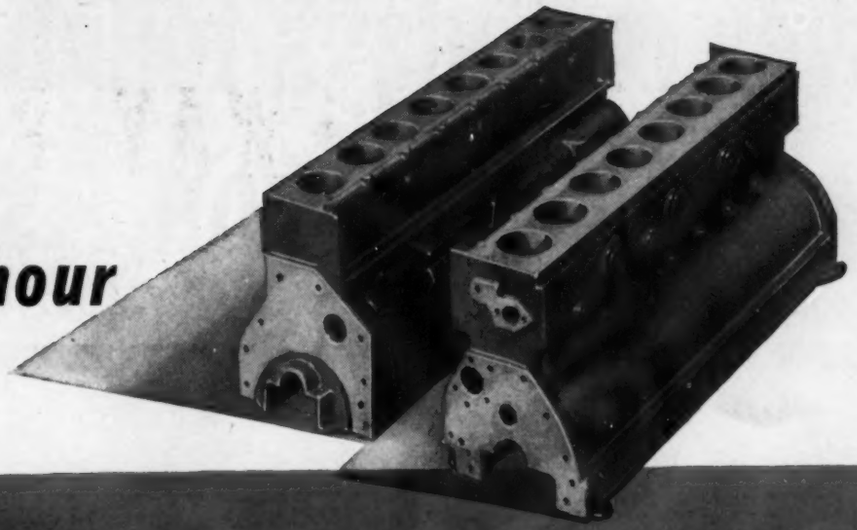
(Automatic Processing)

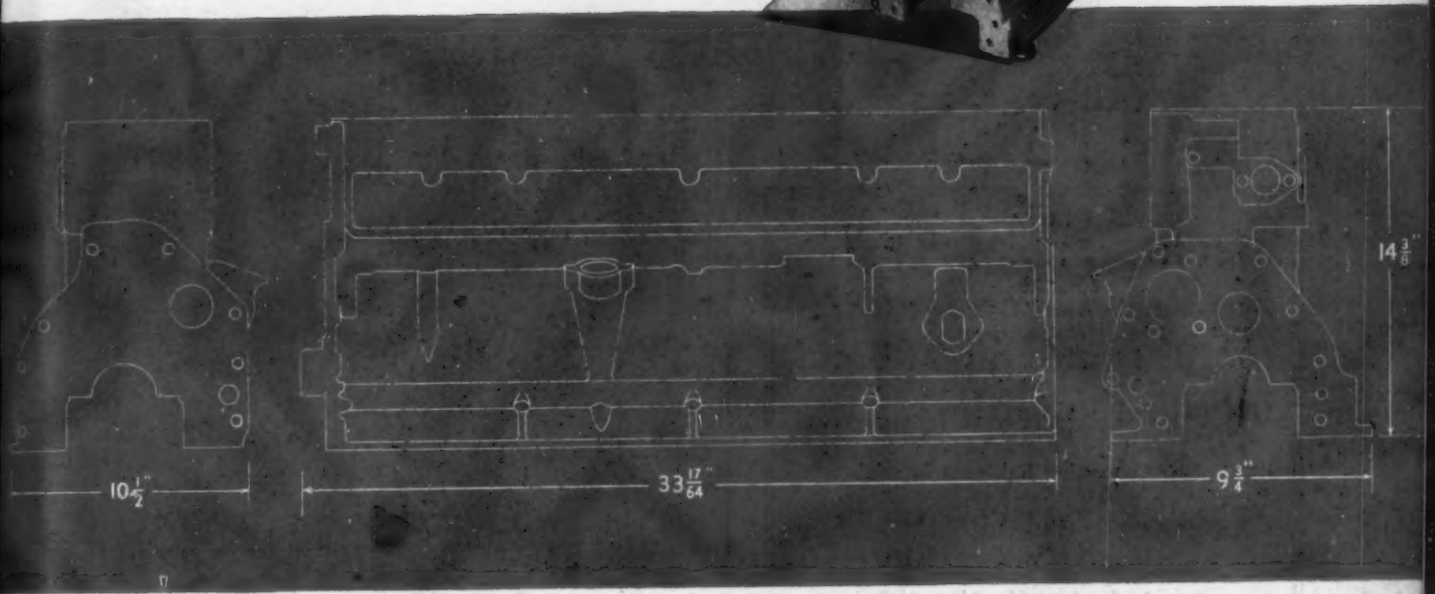
produces 90 engine



Machine

blocks per hour





The NATCO HOLEWAY Processing Machine illustrated at the left produces 90 engine blocks per hour with only one operator. It automatically advances the engine blocks from station to station, clamps and unclamps them in each position, and synchronously performs the operations at all stations as the blocks travel through the HOLEWAY Machine. The blocks are then automatically ejected onto a roller conveyor at the completion of all operations.

The NATCO HOLEWAY Machine illustrated here involves 19 stations and is arranged to complete the following operations: drills 23 holes ranging from 3/16" to ½"; combination drills and countersinks one 7/16" hole; countersinks 14 holes ranging from 3/16" to ½"; taps 15 holes ranging from ⅜" to 7/16" tap; drills 19/32" diameter oil gallery hole clear through engine block in 12 successive steps; taps oil gallery both ends ⅜" pipe tap.

Join the trend to automatic handling . . .

WRITE TODAY For New Illustrated Book!

How NATCO automatic Processing Machines speed productive capacities of both machine and operator is described by actual case studies in a 28-page circular. It will pay you to write for one of these illustrated circulars to see how you can improve your automatic handling methods. Specify NATCO Machine Circular No. 145-T.

NATIONAL AUTOMATIC TOOL COMPANY, INC., RICHMOND, IND., U. S. A. • *Branch Offices:* 1809 Engineering Building, Chicago • 409 New Center Building, Detroit • 1807 Elmwood Avenue, Buffalo • 2902 Commerce Building, New York City

Even on today's toughest Steels CSM's give you Astounding

Slot in S.A.E. 3145 Forging Milled in one pass — metal removal: 21.8 cu. in. per minute!

WORKPIECE: Connecting link used in mining machinery

MATERIAL: S.A.E. 3145 Forging

HARDNESS: 190-200 Bhn

OPERATION: Mill slot 1 13/64" wide x 2¼" deep*

CUTTER: 10" diam. carbide (Lovejoy Slotting)

SPEED: 117 rpm (306 SFM)

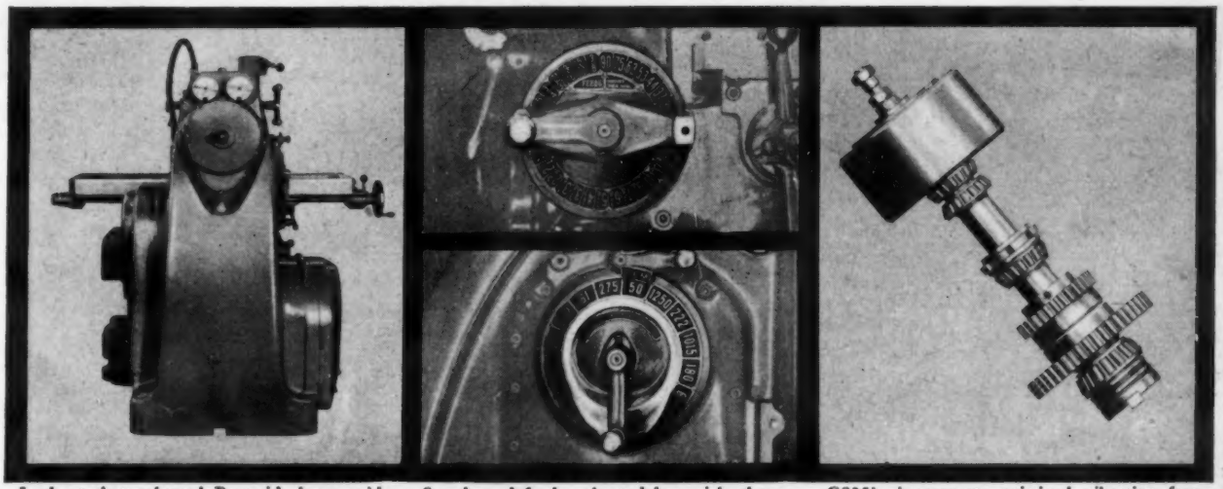
FEED: 7.75 ipm (.0065" per tooth)

RATE OF METAL REMOVAL: 21.8 cu. in. per minute

*Milled in single pass from solid metal section.

Kearney & Trecker super-power new rates of metal removal!

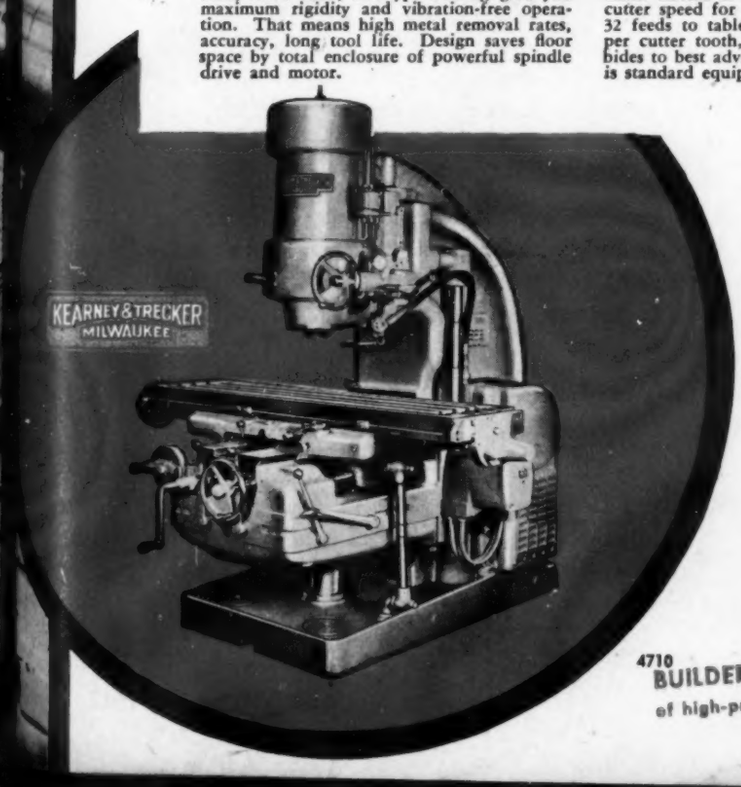
These new super-power Kearney & Trecker CSM's use carbide cutters to fullest efficiency —set amazing new high standards of ferrous and non-ferrous metal removal.



Look at that column! Pyramid shape, wide base, solid back, box-type ribbing give you maximum rigidity and vibration-free operation. That means high metal removal rates, accuracy, long tool life. Design saves floor space by total enclosure of powerful spindle drive and motor.

Speeds and feeds selected by quick-change dials. Choice of 16 spindle speeds mean right cutter speed for use on almost any material. 32 feeds to table and knee mean right feed per cutter tooth, a key factor in using carbides to best advantage. Separate feed motor is standard equipment.

CSM's incorporate original vibration-free three-bearing spindle design. Flywheel, now an integral part of spindle, insures constantly smooth flow of power to cutter. Electrical controls for acceleration and deceleration of gear train are part of basic design. Control interlocks protect operator, cutter and workpiece.



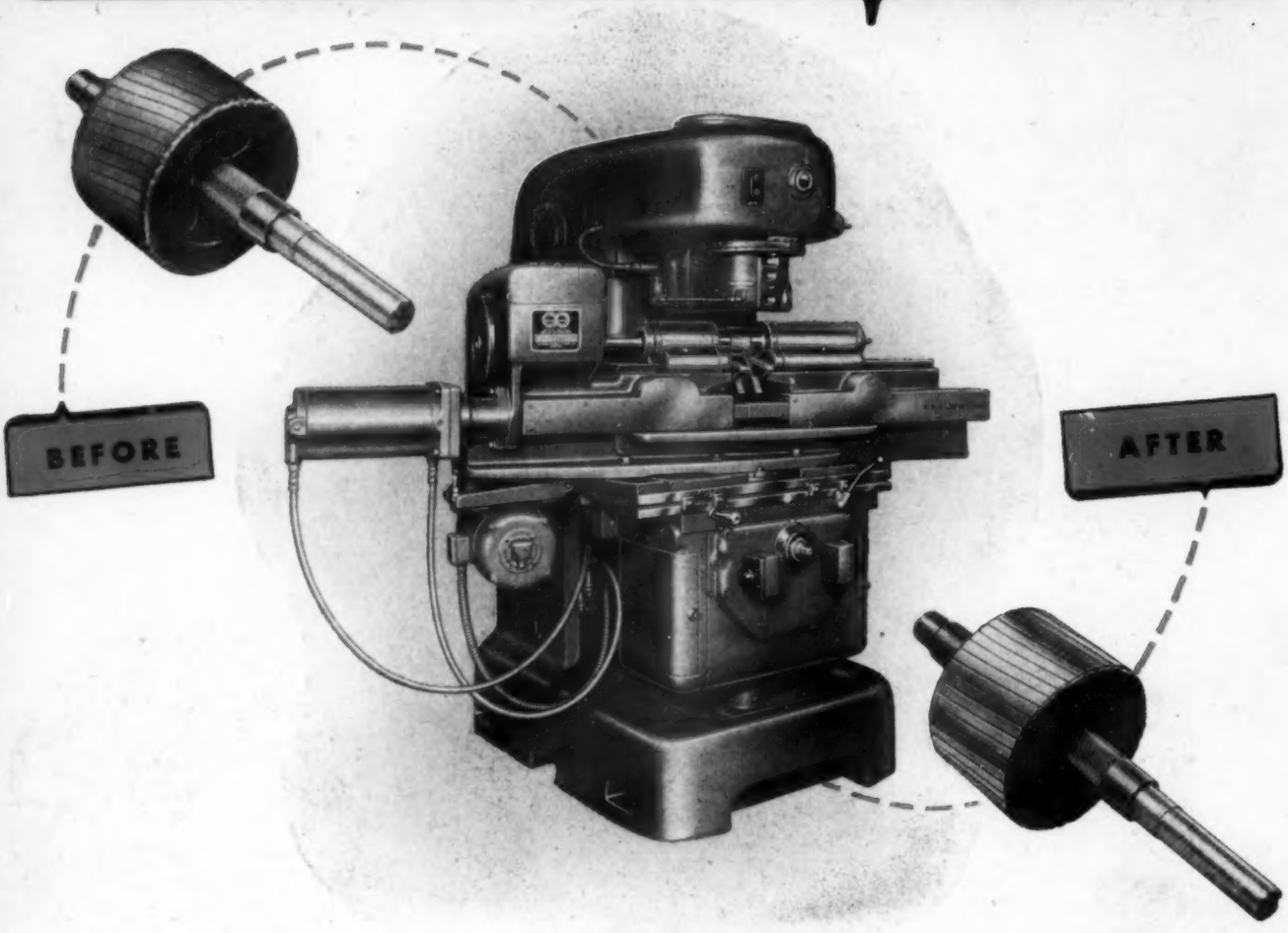
IMPORTANT NOTICE!

Because CSM's are different from any other milling machines — only a check of your production by an experienced Kearney & Trecker engineer, trained in the use of CSM's, can show you the tremendous savings possible. CSM's are made in Plain and Vertical types with 20, 30, and 50 hp. For an on-the-spot personal analysis of how CSM's can increase your production, *wire us collect.* There is no obligation.

KEARNEY & TRECKER CORPORATION
MILWAUKEE 14, WISCONSIN

4710 **BUILDERS OF 97 DIFFERENT MODELS AND SIZES**
of high-production precision milling machines — power rated for every job.

A *Better Way* TO FINISH ELECTRIC MOTOR ROTORS



Turning and grinding the rotor laminations of an electric motor will bring it within run-out tolerance, but it will also smear and close the laminations as well as burr the bar slots. Where efficiency is a factor, a final operation is necessary to open these slots.

Now, there is a new, quicker, better and less expensive way to finish rotors from the rough to close tolerance. The new Red Ring Rotor Shaving Machine Rotoshaves the rotor with a fine pitch precision cutter operating at high speed and on an angle to the axis of the rotor. The result is less machine time, good accuracy and no smearing of the laminations or burring of the bar slots.

A typical case is a 3¼" diameter by 2" face rotor completely finished in one pass (16 seconds) with .030" of stock removed on the OD and to a tolerance of .002" or less. Loading time is 4 seconds. 2598

Write for information based on your own requirements.

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NATIONAL BROACH AND MACHINE CO.

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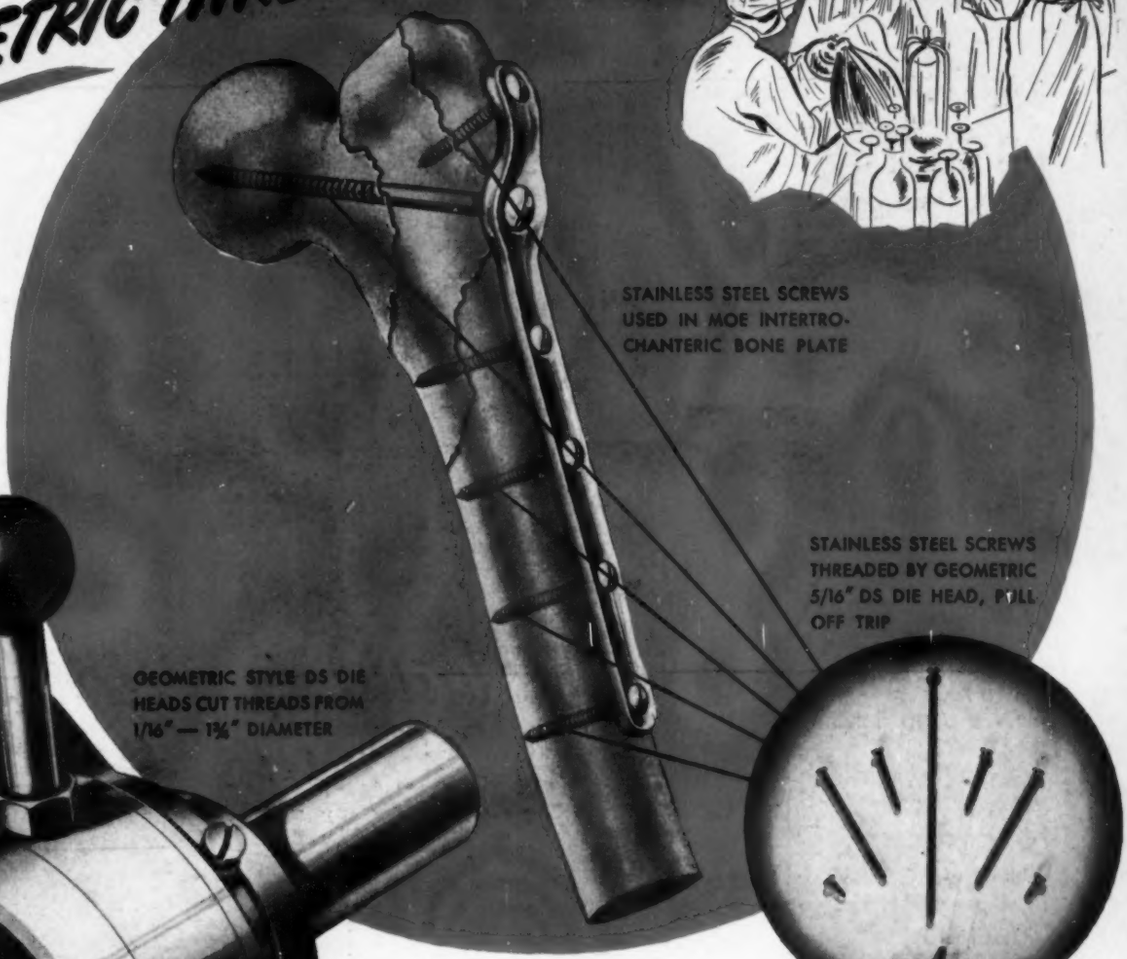
SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE • ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

Modern Surgery AIDED BY GEOMETRIC THREADING METHODS


STAINLESS STEEL SCREWS USED IN MOE INTERTRO-CHANTERIC BONE PLATE
STAINLESS STEEL SCREWS THREADED BY GEOMETRIC 5/16" DS DIE HEAD, PULL OFF TRIP
GEOMETRIC STYLE DS DIE HEADS CUT THREADS FROM 1/16" — 1⅜" DIAMETER

Precision threaded screws of stainless steel, like those shown above, are used to hold together the parts of badly fractured bones and eliminate the old methods of traction during the healing process.

Stainless steel, which is impervious to body chemicals, is tough and hard to cut and naturally the threads on such important work *must be perfect.* That is why a Geometric Style DS Die Head was picked for this job. Geometric Die Heads can be counted on to cut precision threads on the hardest material and give satisfactory performance, without constant regrinding. Whether it's fine surgical screws or large machine parts, there's a Geometric to do the job — *better, easier, faster.*

THE
GEOMETRIC
TOOL COMPANY · NEW HAVEN 15, CONN.
A Division of Greenfield Tap and Die Corporation

SKILLED GEAR CRAFTSMEN . . . MODERN GEAR CUTTING MACHINES . . .

. . . build quality and dependability into every ADAMS GEAR

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- SPLINED SHAFTS
- RACKS
- LEAD AND FEED SCREWS
- GROUND TOOTH GEARS (Spur and Helical)
- SHAVED TOOTH GEARS (Spur and Helical)
- GROUND THREAD WORMS

It takes experienced men and fine machines to make really good gears—Adams has both. In addition, Adams gears are quality controlled at every stage in their manufacture to assure exact conformance with your specifications. This extra care means better performance for your product. And in many cases, custom made gears, designed especially for the application, will cut assembly time and lower unit costs. Write for complete information today. THE ADAMS COMPANY, 1942 Bridge St., Dubuque, Iowa.

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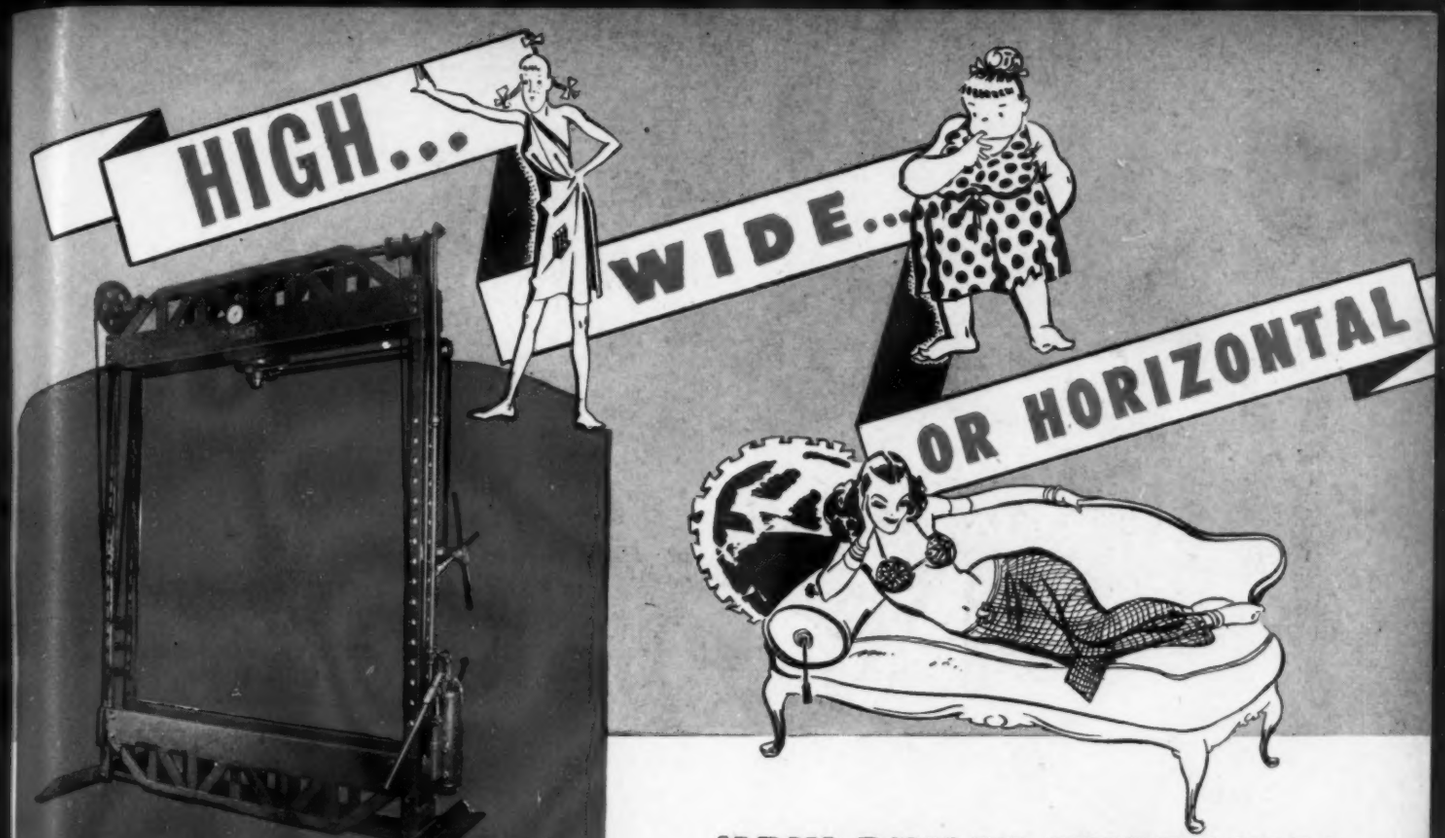
FINE GEARS MADE TO YOUR SPECIFICATIONS . . . ESTABLISHED 1883



KRW BUILDS HYDRAULIC ARBOR PRESSES TO DO *YOUR* JOB BETTER... DELIVERS THEM FASTER ...SELLS FOR LESS

● While KRW builds a standard line of Hydraulic Arbor Presses, a very large percentage of our production consists of special adaptations such as are illustrated here. These special presses generally cost little more than the standard presses because of KRW mass production methods and the fact that, outside of larger frames, they are built almost entirely of standard components. Any KRW press can be either hand-operated, air-operated or motor-driven, in capacities from 25 to 75-tons. If you are faced with a production problem that might be solved with *any* type of hydraulic press, you can save time and money by telling us your needs. Our hydraulic press engineers will work out a practical solution...without obligation...of course. Mail the coupon.

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A sure start on Lathe Profits

Axelson Lathes, of various lengths, are manufactured in 14, 16, 18, 20, 25 and 32-inch sizes.

The profit margin on any metal turning job hinges largely on the performance of the lathe used... When the "Start" button is pressed on an Axelson Heavy Duty Lathe, this starts your metal turning profits too... Then again as the lathe *cuts* it *cuts* the overall piece production cost to the lowest possible minimum... Built to maintain the utmost in accuracy, at the lowest upkeep cost, Axelson Lathes long have proven their worth in production lines throughout the world... Axelson Lathes *cut* metal and *costs* alike.

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AXELSON

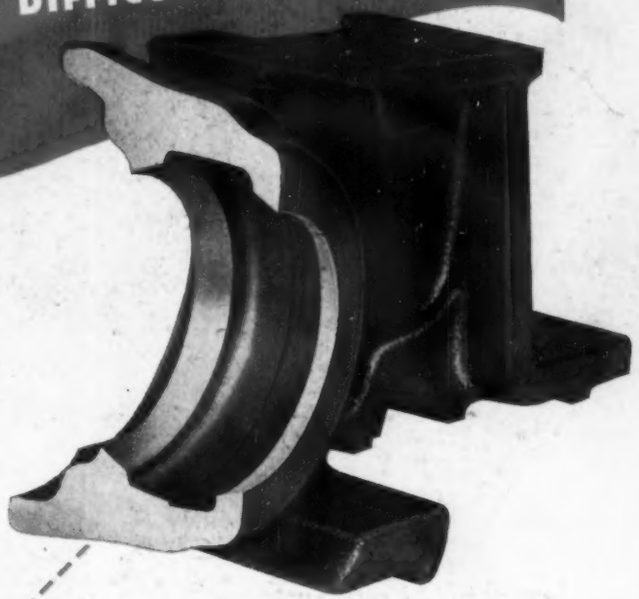
THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

Lathes

DEPENDABLE FOR OVER A QUARTER CENTURY

Job Engineered CUTTERS

WILL DO A BETTER JOB ON DIFFICULT MILLING CUTS



WITH MORE TOOL LIFE

SIMPLIFIED TOOLING

FEWER REJECTS

FASTER FEEDS AND SPEEDS

MORE EFFICIENT PRODUCTION

A single milling set-up may be the answer to some of your complicated machining problems, too. With milling cutters designed *particularly* to suit the problem, several cutting operations can be combined, and production can be made easier, faster, trouble-free, and more profitable. That's what we mean when we say *Job-Engineered Cutters* will do a better job for you on special milling problems.

Here's a typical example. This bearing bracket has an internal ball race with a combination of surfaces to be milled in several planes. The perimeter must be accurately round to give smooth bearing action. The bearing surface must be tapered in opposite directions on each side of the race to contain the bearing. The material is abrasive, and hard on tool life. Conventional milling will require several cuts and handling of the piece, plus special fixtures.

Barber-Colman Cutter Engineers, when consulted on the job, designed a special ball-nosed end mill to complete the operation in one cut. The special form built into the cutter controls accuracy, finish and surface location automatically, making the job easier for the operator and contributing reduced cost per piece. Cutting clearances and tooth form engineered for these particular conditions take care of the abrasive action and proper disposal of chips, to produce 5000 brackets per cutter sharpening.

This type of cutter efficiency is possible with tools engineered-for-the-job, because cutter elements are present to meet *all* of the conditions. Try B-C Job-Engineered Milling Cutters on your next production problem and experience the satisfaction of having fewer operations, simplified tooling, faster production and trouble-free machining. Send us your blueprints and sample parts for analysis and quotation.

QUICK JOB FACTS

Operation—Mill .060" stock from bearing race.

Material — Cast iron.

Cutters — B-C Job-Engineered Ball Nosed End Mills, 3¼" dia.

Feed — 4½" per minute.

Cutting Time — 20 min. per piece.

Speed — 40 RPM.

Tool Life — 5000 pieces per sharpening.

WRITE **for a copy of Milling Cutter Data, which describes other field problems in economical milling on a variety of parts. A request on your company letterhead will bring you a copy promptly.**

MODERN MACHINES WITH ORDINARY BARBER B-C COLMAN **CUTTING TOOLS ARE NOT FULLY EFFICIENT**

Barber-Colman Company

GENERAL OFFICES AND PLANT 111 LOOMIS ST. ROCKFORD, ILLINOIS U.S.A.

Fig. 1. Sundstrand Standard Rigidmil machining pump cylinder block sleeves. Note standard Sundstrand Automatic index base attachment which automatically positions part for milling 12 grooves.

How SUNDSTRAND "Engineered Production" Improves Milling Methods

Machine Time Cut From 3 Hours to 8 Minutes With STANDARD RIGIDMIL

This completely automatic Rigidmil is standard, including the vertical feed attachment. Loading and unloading the workpiece and starting the machine cycle constitutes the operator's duties. The 12 grooves in the pump cylinder block sleeve were formerly machined in 3 hours. The Sundstrand Rigidmil automatically machines the 12 grooves at the rate of 7½ pieces per hour. In addition, compared to the previous method of machining, the operator's duties are greatly simplified.

Profitable milling production can be obtained only by lowering *unit* production costs . . . obtaining the most economical solution to your milling problem and the most productive milling equipment in relation to your production requirements.

Basically, there are two apporaches to solving these problems, (1) obtaining standard machines, then trying to process parts over these machines as economically as possible, (2) designing the most profitable processing method, then obtaining machines to suit this method — standard or semi-standard machines, if possible, or entirely special machines, if necessary.

This latter method is Sundstrand "Engineered Production" . . . the most practical approach to economical milling. The following is a brief resume of the complete engineering and manufacturing service available from Sundstrand to meet all or any of your production milling requirements in small and medium size work.

These actual examples are presented to reveal one of each of the methods used in solving milling production problems. One of these methods may be the solution to your present problem.

SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U.S.A.

RIGIDMILS • FLUID SCREW RIGIDMILS • AUTOMATIC LATHES • HYDRAULIC EQUIPMENT

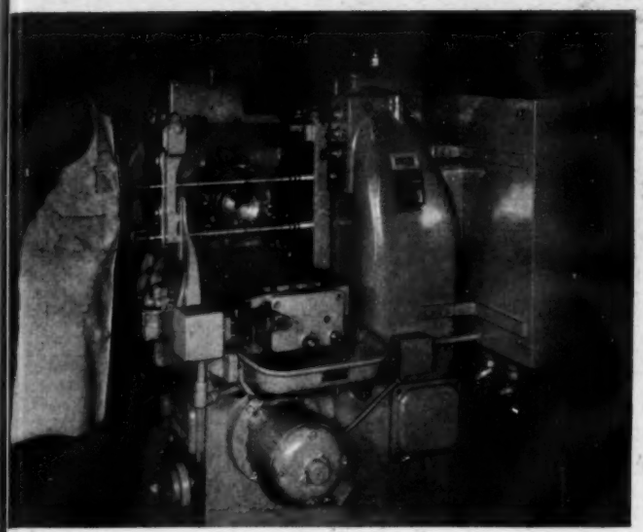


Fig. 3. Operation view of Sundstrand Rigidmil machining 84 slots in type bar segment.

STANDARD RIGIDMIL With Special Head Mills 84 Slots in One Setting

This standard Rigidmil has been provided with a special 2 spindle horizontal head. In addition, a special Sundstrand automatic index base is mounted to the machine table. The work holding fixture mounted to the automatic index base holds one part. The part has 84 slots — 42 in upper half and 42 in lower half. In using the automatic index in conjunction with an automatic machine cycle, all 84 slots are milled automatically with only one handling of the work piece. The cut is of the "plunge" type. Consequently the machine is equipped with a positive stop and dwell attachemnt so that the length of feed stroke (depth of cut) is held within limits of —.001". Three different sizes of parts are machined on this Rigidmil.

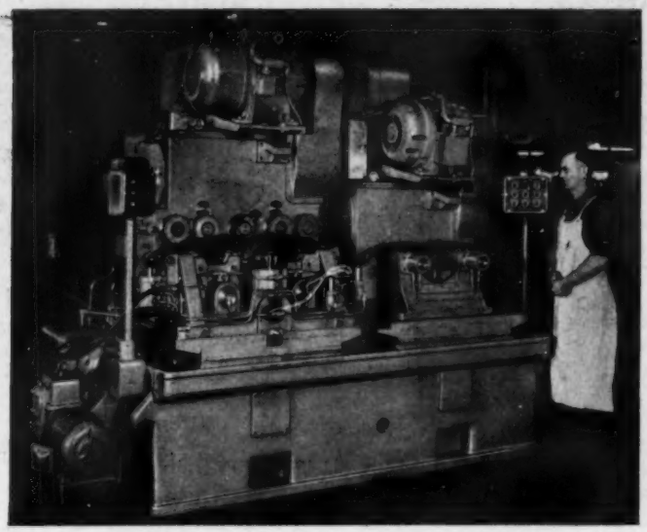


Fig. 5. Special Sundstrand Twinplex Rigidmil. Machine is provided with 16 spindles for milling manifolds in two stations.

SPECIAL RIGIDMIL Mills 11 Surfaces in 2 Settings

The shape of the part together with production requirements called for a special machine to mill these manifolds. Operations include rough and finish milling port faces and back facing washer seats on port flanges. The special Sundstrand Twinplex Rigidmil has a ten spindle head on left hand column, for rough and finish milling the five port faces — the six spindle head on the right hand column mills the seats on the port flanges. The manifold is transferred from left to right with the operator loading at one station while a part is being machined in the adjoining station. The fixture at the left hand station is automatically retracted on the return stroke of the head so that the cutters do not drag over the finished milled surface.

Free ADDITIONAL DATA

Write for more proof of the successful application of Sundstrand "Engineered" milling production. Our Booklet entitled "Practical Milling Methods" contains over 60 problem solutions complete with tooling diagrams. Ask for Bulletin 161

SUNDSTRAND MACHINE TOOL COMPANY

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remember—better springs make better products.

THE technical "know-how" acquired in more than a century of manufacturing wire products . . . plus greater precision in inspection and manufacture are the reasons for the outstanding performance of U·S·S American Quality Springs.

These superior springs resist fatigue and hold their shape with unusual success. They give additional life to your product.

When you specify American you get better springs for your product. And because our production facilities are second to none, you can usually count on speedy delivery of springs in *whatever* quantity you need.

Let our spring engineers help you select the right springs for your product. No matter what type you need, we can supply them . . . for we produce every type and size of compression, extension, torsion and flat springs in common use.

THE JOHN DEERE AUTOMATIC BALER

The vitally important tooth bar spring on the pick-up as well as several other springs on the press are American Quality Springs.

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UNITED STATES STEEL

AMERICAN STEEL & WIRE COMPANY · USS · AMERICAN SPRINGS · UNITED STATES STEEL

U·S·S American Quality Springs

This town became world famous..

Greenfield, Massachusetts, is just as beautiful today with its elm-shaded streets and colonial homes as it was 75 years ago. But during those years it has become world famous as the home of fine threading tools. These GTD "Greenfield" tools are used in every part of the world where metal working is done. They have played a key role in the Machine Age that has freed mankind from drudgery. The modern American threading tool industry was born in Greenfield in 1872 with an idea for a better die. The chief industry of this little town in Pioneer Valley has never ceased pioneering in its field to this day. Wherever threading tools are used, the name GTD "Greenfield" stands for quality.

GTD Greenfield 75TH YEAR

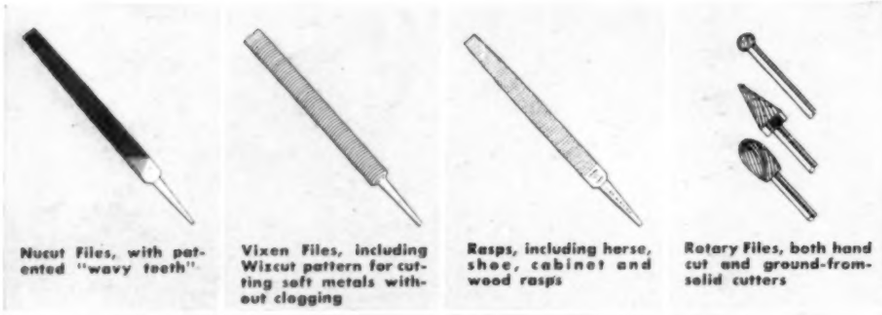
A major pioneering feat in internal threading was the development by GTD "Greenfield" of the "Gun" Tap. It is made with fewer flutes and a spiral point which causes the tap to cut a curling chip that is "shot" ahead. The design produced a stronger tap and eliminated the tendency of chips to clog the flutes, a principal cause of tap breakage, and stepped up production standards.

GREENFIELD TAP and DIE CORPORATION
Greenfield · Massachusetts

The GEOMETRIC TOOL COMPANY
New Haven, Connecticut · In Its Fifty-Fourth Year

NUCUT WAVY TOOTH FILES

TOOL FAVORITES...



Nucut Files, with patented "wavy tooth"

Vixen Files, including Wixcut pattern for cutting soft metals without clogging

Rasps, including horse, shoe, cabinet and wood rasps

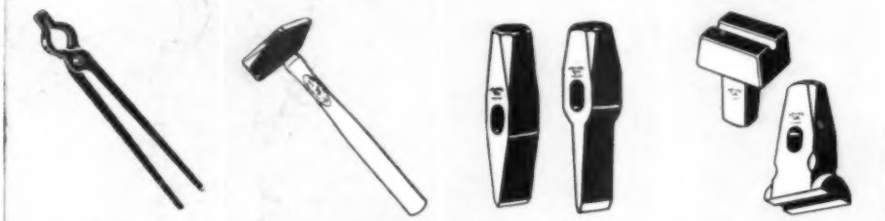
Rotary Files, both hand cut and ground-from-solid cutters

Machinists' Ball Pein Hammers

Carpenters' Bell Face Nail Hammers

Masterenches, with pipe or smooth jaws

Hand Punches

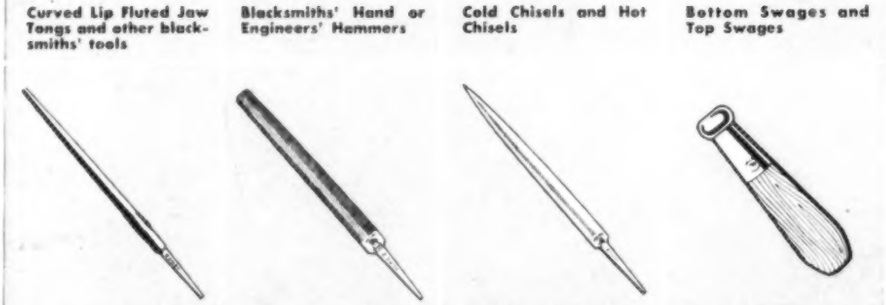


Curved Lip Fluted Jaw Tongs and other blacksmiths' tools

Blacksmiths' Hand or Engineers' Hammers

Cold Chisels and Hot Chisels

Bottom Swages and Top Swages



Mill and Saw Files

Special Purpose Files, for aluminum and other metals and alloys

Swiss Pattern Files, for die, tool and other intricate work

File Handles and File Cards

for busy Craftsmen!

Today you want tools that work faster, easier! Tools that can be counted on for better performance! Tools of the right heft and balance! Tools, in brief, that you can employ with confidence—that help strengthen *your* reputation for fine workmanship!

Exacting requirements! Yet you can meet them all with Heller tools. So decide now to learn more about the complete Heller Tool Line. See your distributor.

Heller tools are made from our own formula of specially refined tool steel. This advantage, among others, in addition to our many years experience in fine tool making, enables us to produce tools of uniformly high quality, acknowledged by users to be superior to anything else on the market.

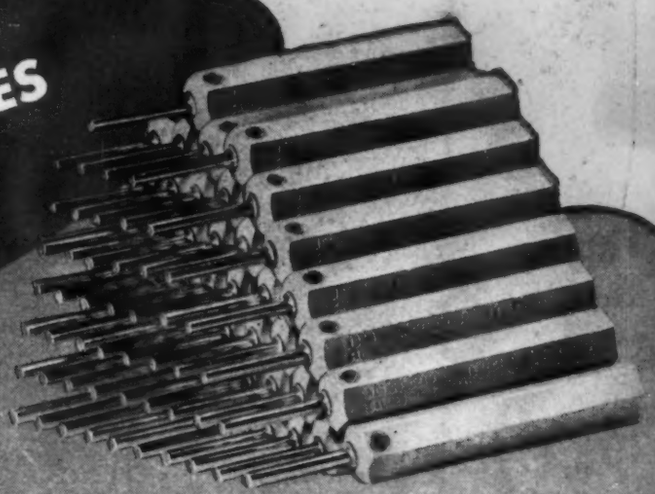
HELLER BROTHERS COMPANY

Newark, N. J. Newcomerstown, Ohio

Good Tools Since 1836

Van Keuren

CARBOLOY WIRE TYPE PLUG GAGES



1 VAN KEUREN CARBOLOY GAGE = 50 TOOL STEEL GAGES

Wire type plug gages were originated by The Van Keuren Co. in 1925 and are now recognized as the most economical gages for measuring small holes.

The original wire type plug gages were made of tool steel. The use of high speed steel doubled gage life. Precision chrome plate gave five times the life, and now gages of carboloy are available with fifty times the life of tool steel. All of these materials are still in use and have their particular applications and advantages.

VK Carboloy gages are made in sizes from .020" diameter to .250" diameter. They are available only in the wire type design as this is by far the most economical small plug gage. In cases where it is desired to use Van Keuren carboloy wire type Go units with existing No Go units of the taper insert design, special handles can be furnished for this purpose. Van Keuren wire type plug gages assure longer lasting precision and lower gage cost because the entire 2" length of gage unit can be used. When the end becomes worn it is ground off and a new section of the original accuracy is moved out for use. The wire type unit is securely held in the handle by a split bushing and a headless set screw.

VK Carboloy wire type plug gages are made to Class B accuracy, plus .00005" minus .00000" on the Go unit and plus or minus .000025" on the No Go unit. Closer or wider tolerances can be supplied if desired.

On your next order specify VK wire type plug gages. VK Carboloy for long runs because of the enormous saving in gage cost. VK Carboloy for fussy jobs because of the infinitesimal gage wear and insurance that the parts will be within the specified limits. VK Tool Steel—High Speed—Precision Chromium for less exacting jobs. You will be assured of the best in accuracy, quality and delivery.

Write for circular C 35 on Carboloy wire type plug gages, Thread measuring wires and Gear wires.

Write for your copy of catalog and handbook No. 33. It contains complete information on Van Keuren precision gages and instruments and valuable engineering formulas and data on measuring problems.

THE Van Keuren CO., 176 WALTHAM STREET, WATERTOWN, MASS.

28th YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages • Carboloy Measuring Wires

Put it on the Blanchard

¼" of stock is removed from each of 4 sides

PRODUCTION RATE IS TRIPLED!

ANOTHER BLANCHARD "ROUGH-TO-FINISH" JOB . . . **IF YOU MACHINE FLAT SURFACES, INVESTIGATE BLANCHARD GRINDING for finishing them from the "rough" (casting, forging, torch cut, etc.) to the smooth, flat, *sized* finish in one handling—one operation.**

The above illustration shows one actual example of Blanchard cost-cutting "hogging". The parts are cast iron Bearing Gibs, held by simple blocks on the 36" diameter magnetic chuck of a No. 18 Blanchard Grinder. Each gib half is 36" x 4" x 1⅝".

***One-quarter inch* is removed from each of the four sides. The finished edges must be accurately square with the sides.**

THE PRODUCTION RATE ON THE BLANCHARD IS 33 TIME UNITS PER PIECE, AS COMPARED TO 100 TIME UNITS PER PIECE WHEN MACHINED BY THE FORMER METHOD.

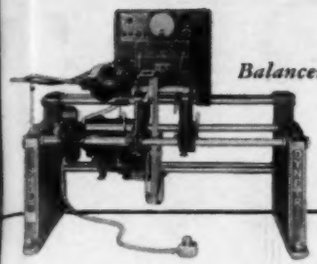
We'll be glad to study *your* flat surface grinding problems—give you reliable production data—and grind samples for you. Without any obligation on your part!

Send for your free copy of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

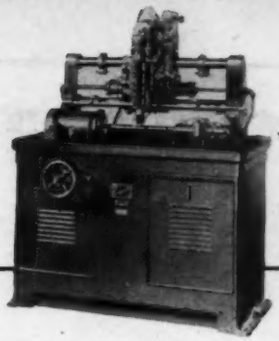
BLANCHARD

The BLANCHARD MACHINE COMPANY

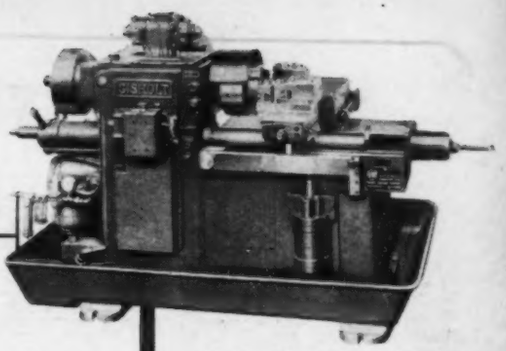
64 STATE STREET, CAMBRIDGE 39, MASS., U. S. A.



Balancers



Superfinishers



Hydraulic Automatic Lathes

If you produce parts that are Round or Semi-Round

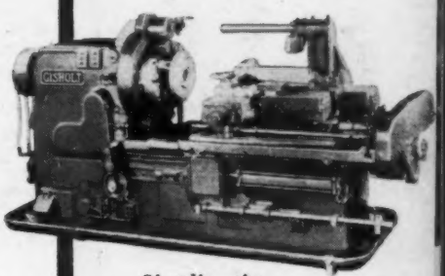
meet us at the "GISHOLT ROUND TABLE"

Yes, for a half century, here at Gisholt, we've concentrated our efforts upon the building of equipment to produce parts that are round or semi-round. And a good share of our job is helping others to use it most efficiently.

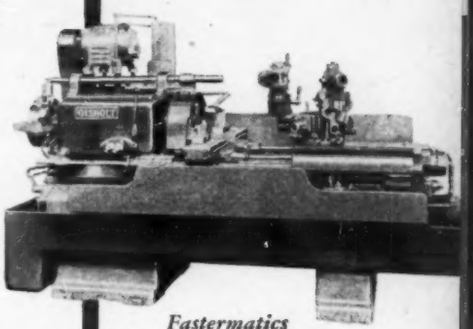
There's where the "Gisholt Round Table" comes in—as a clearinghouse for practical ideas. Gisholt engineers live with production problems day in and day out, visiting hundreds of plants each year. Whatever your work may be in the realm of machining, surface-finishing or balancing of round or semi-round parts, Gisholt specialists will gladly help you.

Now, and in the years ahead, more emphasis than ever will be placed upon better methods, increased efficiency and lower costs.

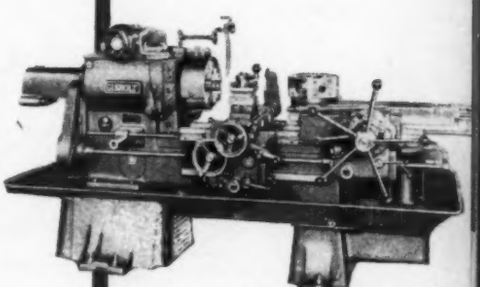
Call your nearest Gisholt Representative. Or, if you wish, come to Madison and consult the "Gisholt Round Table."



Simplimatics



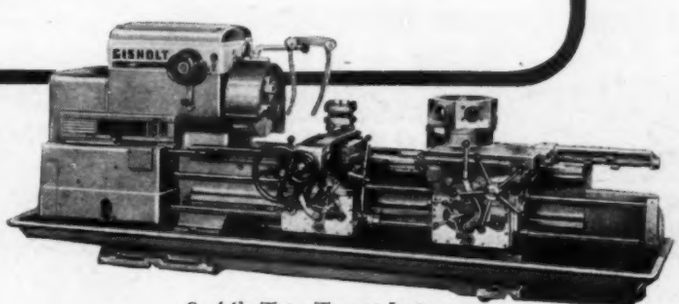
Fastermatics



Ram Type Turret Lathes

GISHOLT MACHINE COMPANY
Madison 3, Wisconsin

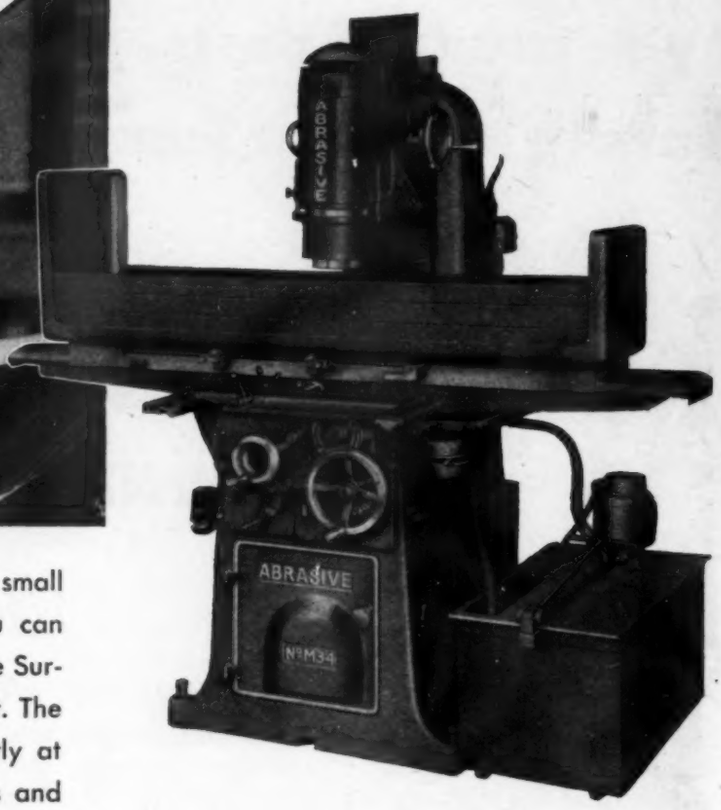
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS
BALANCERS • SPECIAL MACHINES



Saddle Type Turret Lathes

See all these—and other Gisholt machines on actual production jobs at the Machine Tool Show.

THAT'S A JOB FOR THE ABRASIVE M-34



When the job requires grinding flat work — small dies, spacers, parallels, washers, etc. — you can count on the ABRASIVE M-34 Vertical Spindle Surface Grinder for big production at lower cost. The motorized spindle delivers full 5 H.P. directly at the cutting point, eliminates belting troubles and speeds the production of accurate work. For extra stock removal or grinding a concavity, the spindle may be tilted at a slight angle. Feeds are automatic — both vertical and longitudinal, and the table reciprocates smoothly, with a hydraulic shock absorber to cushion table reversal. From its massive bed casting to its one-shot oiling system, ABRASIVE M-34 is built for a long life of high production.

Write for Bulletin

ABRASIVE
ACCURACY BOOSTS PRODUCTION

SPECIFICATIONS

Work Capacity: 24" long, 8" wide, 12" high.
Spindle: Built-in 5 H.P. motor, 3450 r.p.m., ball and roller bearing.
Wheel size: Segment Type, 6" diameter.
Table Size Overall: 59" x 10½".
Net Weight: 3000 lbs.

• • •

For information on ABRASIVE machines on the Government Machine Tool Surplus Lists send us the machine serial numbers. We will endeavor to supply attachments, accessories, and repair parts as desired.

ABRASIVE MACHINE TOOL CO.
EAST PROVIDENCE 14, RHODE ISLAND

•

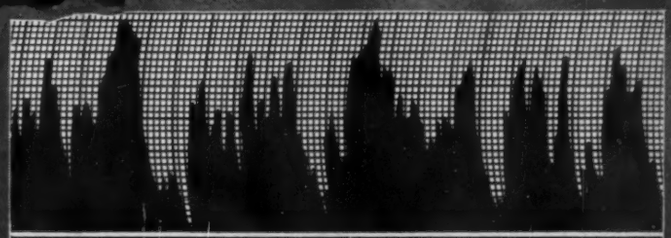
like skating on cinders!

How long could rollers stand this? Not long . . . yet bearings must stand this same kind of punishment with a typical "finished" surface.

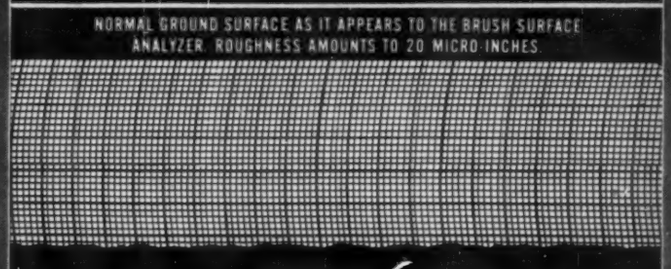
There it is, at the right, an actual profile of a normal ground surface as shown by the Brush Surface Analyzer. Look at those ups and downs, and you'll see why bearings wear out before their time.

Now look below at the Brush analysis of a *Superfinished* surface. Smooth? Yes, *seven times as smooth* as the usual ground surface! No grinder scratches, no feed spirals, no chatter marks, no fragmented metal.

Without such defects to rupture the protective film of oil, the life of a bearing has no limit. So it pays to know about Superfinishing . . . and Gisholt engineers are ready with the facts.



NORMAL GROUND SURFACE AS IT APPEARS TO THE BRUSH SURFACE ANALYZER. ROUGHNESS AMOUNTS TO 20 MICRO-INCHES.



BRUSH ANALYSIS OF A SUPERFINISHED SURFACE SHOWS A SMOOTHNESS OF 3 MICRO-INCHES.

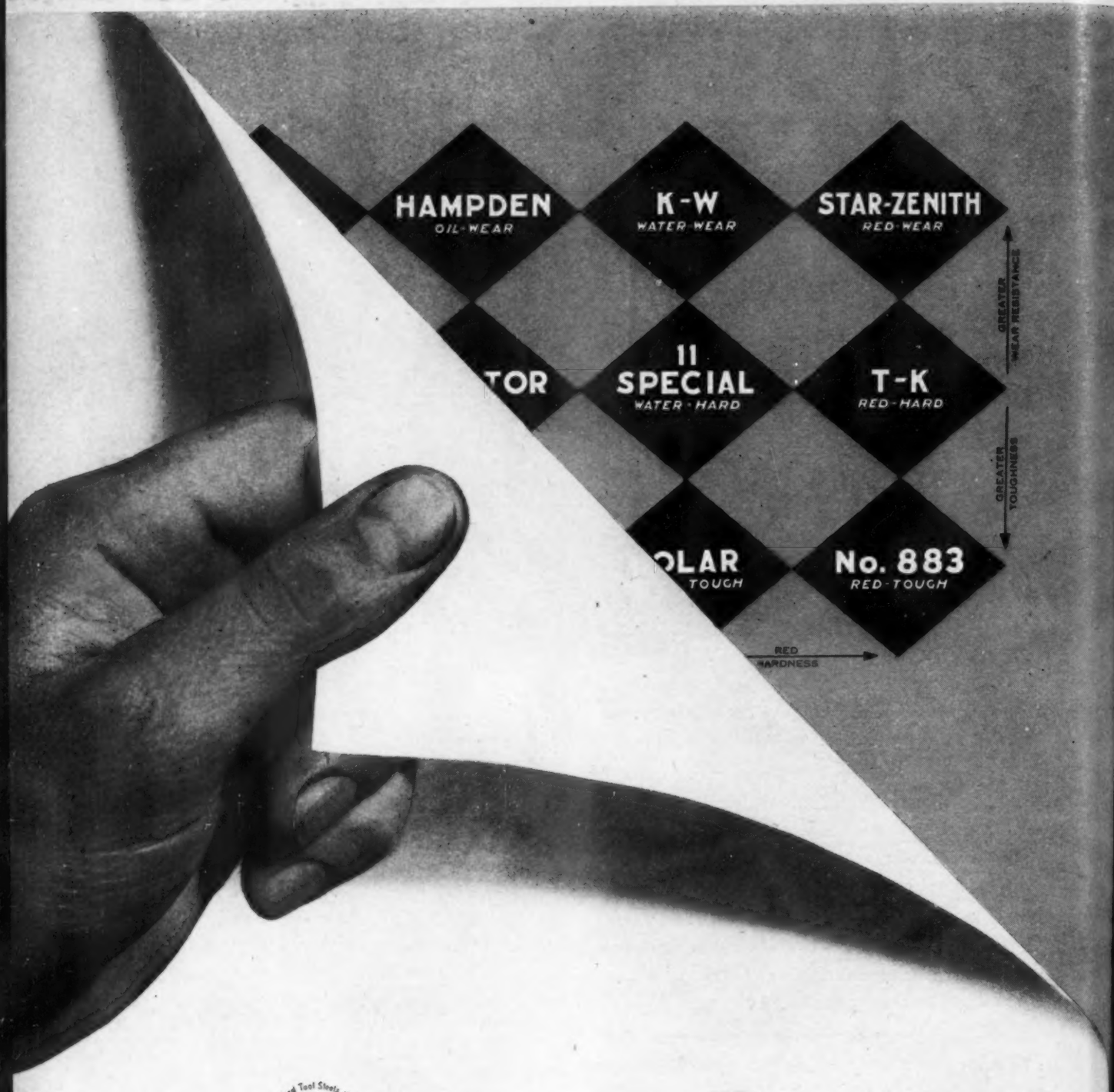
THE GENERAL PURPOSE SUPERFINISHER is a self-contained unit, simple to operate. Handles a wide variety of miscellaneous or production work. Also available — — specialized machines for all requirements.

GISHOLT MACHINE COMPANY

1245 E. Washington Ave. • Madison 3, Wisconsin

THE GISHOLT ROUND TABLE

represents the collective experience of leading specialists in the machining, surface finishing, and balancing of round or semi-round parts. Your problems are welcomed here.



The Standard Tool Steels of Industry

Carpenter MATCHED TOOL STEELS

The Carpenter Steel Company, General Office and Mills; Reading, Pa.

Baltimore
Birmingham, Ala.
Boston
Buffalo
Chicago
Cincinnati
Cleveland
Dayton
Detroit
Hartford
Houston
Indianapolis
Los Angeles
New York
Philadelphia
Providence
St. Louis
Worcester, Mass.

In Canada:
Toronto
Montreal

NOW

a new *Carpenter* Matched Set...

TO HELP YOU SOLVE TODAY'S TOOLING PROBLEMS!

- ★ Higher Output!
- ★ Lower Unit Costs!
- ★ Simplified Tool Steel Selection
- ★ Safe, Accurate Heat Treatment
- ★ Reduced Tool Steel Inventories

Here is one way to modernize your tool room without spending a cent!

Since 1934, Carpenter customers have been getting the benefit of the Matched Set Method. Now a *new* Carpenter Matched Set has been developed to help you meet today's demands for higher performance and lower unit costs.

The new Carpenter Matched Set of 12 Tool Steels can solve practically any problem that comes up in your tool room. Selecting the right tool steel for top performance on each job is greatly simplified. By following this method you can know in advance what results to expect as you switch from one steel to another. And think of the savings in *reduced inventories alone*—because you need stock far fewer steels!

Find out now how the new Matched Set can help you modernize your tool room—reduce costs all along the line from tool making to finished output. Ask your Carpenter representative for the new Carpenter Matched Tool Steel Manual. Use its 189 pages of selection and heat treating data—and get all the benefits of the new Matched Set, now.

FOR IMMEDIATE DELIVERY

Call Your Carpenter Warehouse or Distributor

The NORTON 10" TYPE CD is a husky machine for heavy work

THE NORTON 10" Type CD Machine handles the heavy duty cylindrical grinding jobs — either plunge cut or traverse types — with outstanding efficiency because:

1. **Base casting massively proportioned** and designed low to ease work handling and control — only 35" from work center-line to floor.
2. **NORTON heavy-duty wheel slide unit** — takes 36" or 42" diameter grinding wheels.
3. **Husky head and footstocks** give strong work support under heavy, rapid stock removal — 2" diameter centers.
4. **Famed NORTON "Spark Splitter"** available for shoulder grinding work — eliminates necessity for jogging table.

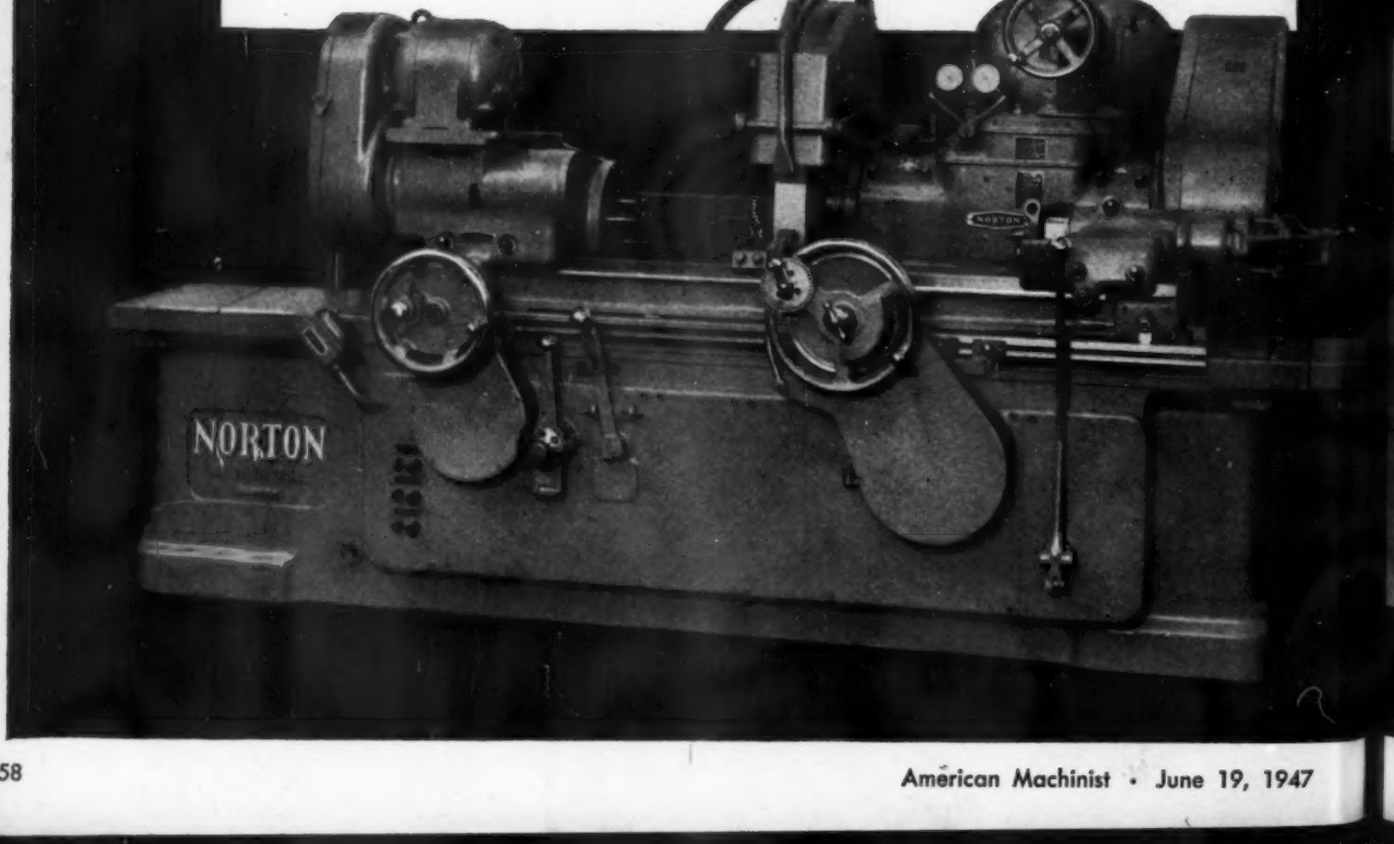
Write for catalog No. 1023 which gives further illustrations and details.

NORTON COMPANY, WORCESTER 6, MASS.

New York - Chicago - Detroit - Cleveland - Hartford

Distributors in All Principal Cities

M-544

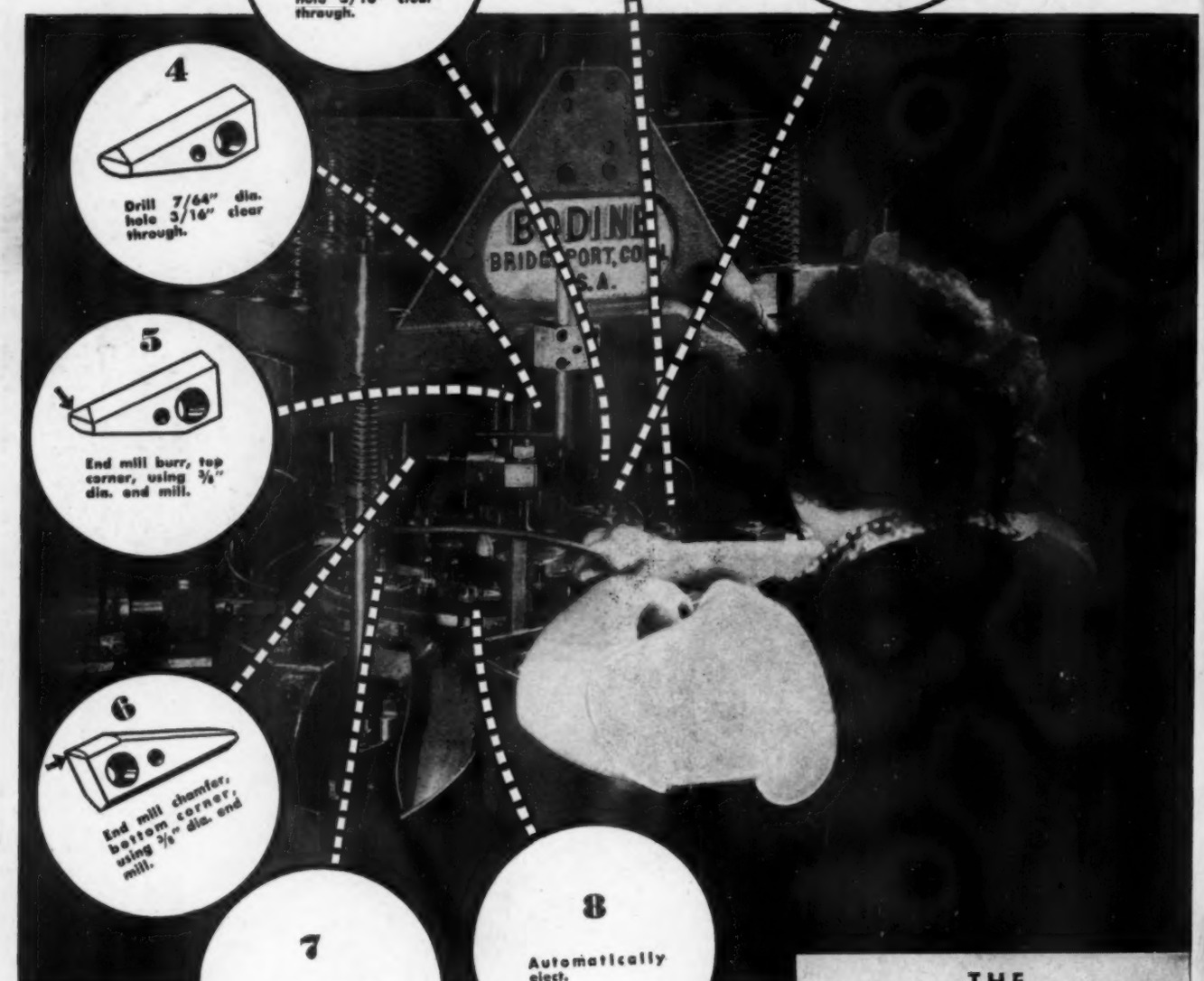


Are You Grinding Crankshaft Bearings?
NORTON GRINDERS
and Lappers

Bodine...Case History No. 15

Producing a Steel Chuck Jaw....

ACTUAL SIZE



This Bodine automatic Multi-spindle, horizontal dial machine is producing 550 pieces per 50 min. hour at one piece per stroke of the machine at the Jacobs Mfg. Co., Hartford, Conn. It can do a similar job for you.

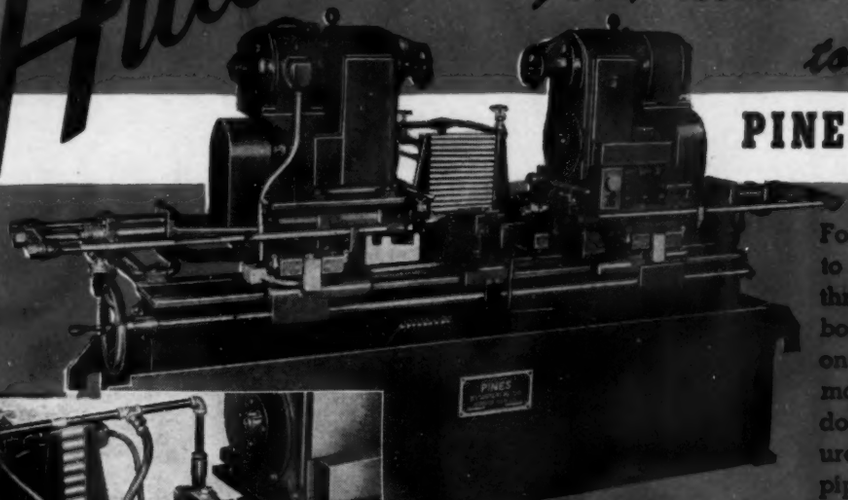
THE
Bodine
CORPORATION
BRIDGEPORT 9, CONNECTICUT

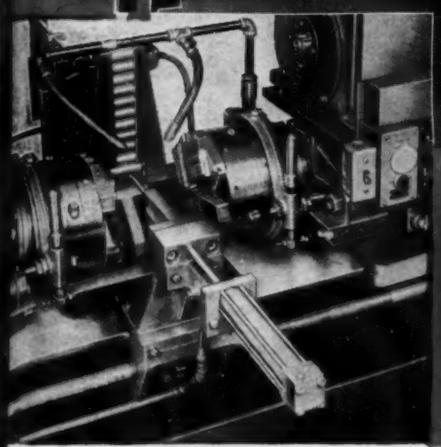
AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

PINES *Automatic* TUBE FABRICATING EQUIPMENT

For Precision High Speed Production to Close Tolerances!

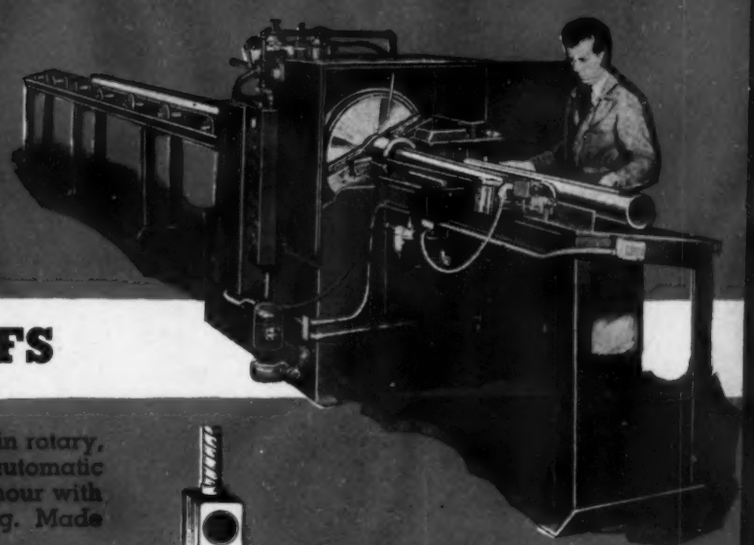
PINES *Automatic* PROFILERS





For processing tubes from the smallest sizes up to 6" O.D. and 100 feet long. Operations include threading, burring, chamfering, facing, flaring, boring, centering, turning, drilling and reaming, one or both ends simultaneously. Pines Automatic Profilers are made in 3 sizes, single and double spindle types. A typical production figure is 1500 ¾" burred tubes per hour or 700 ¾" pipe nipples threaded per hour.

Heavy Duty Construction

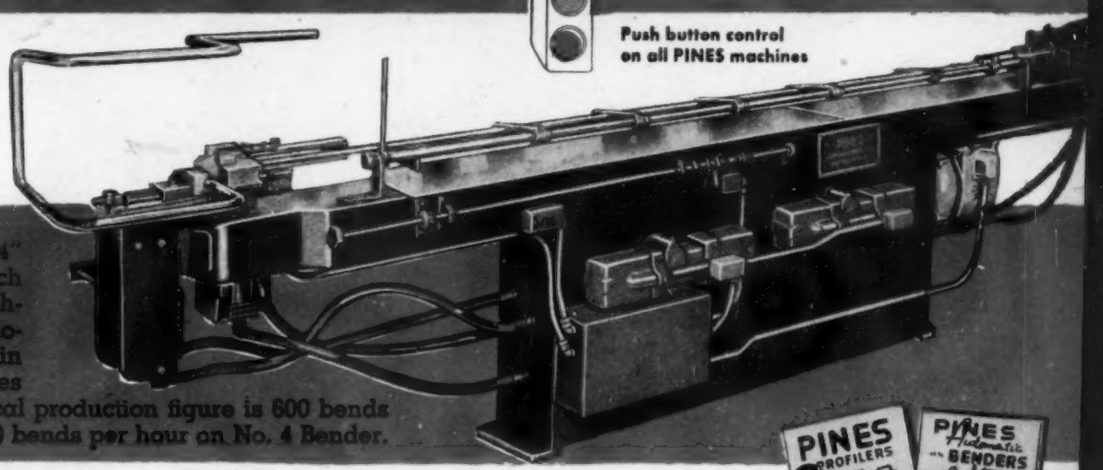


PINES *Automatic* CUT-OFFS

For cutting off tubes of any size or kind up to 5" O.D. Made in rotary, friction and disc types, all of which are available with full automatic operation. A typical production figure is 1500 2" tubes per hour with friction cutting and 150 5" tubes per hour with rotary cutting. Made in 3 different sizes.

Push button control on all PINES machines

PINES *Automatic* BENDERS



or bending tubes or pipe up to 4" O.D. Many exclusive features such as the patented Booster Attachment, Angle-of-Bend Selector, automatic Mandrel Extractor. Made in standard sizes and special types for specific applications. A typical production figure is 600 bends per hour on No. ¾ Bender and 60 bends per hour on No. 4 Bender.

PINES ENGINEERING CO., INC.

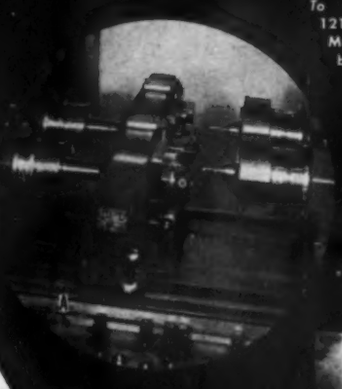
675 WALNUT ST. • AURORA, ILLINOIS • Phone Aurora 2-7608

Write for Catalogs

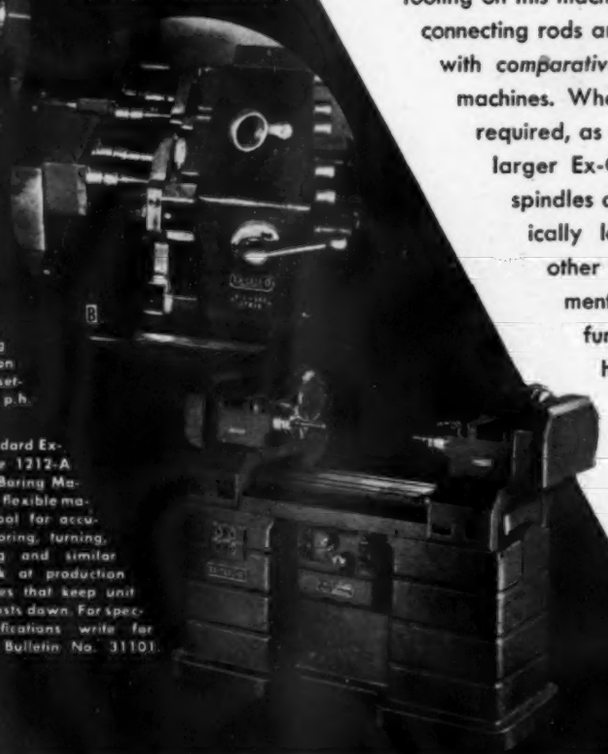
SPECIALISTS IN TUBE FABRICATING EQUIPMENT

YOU GET ALL 3

with EX-CELL-O *Standard* Precision Boring Machines



To left: Ex-Cell-O Style 1212-A Precision Boring Machine equipped to rough bore the large hole, chamfer one edge; cut an oil groove and chamfer both edges of the small hole in aluminum connecting rod. Production is 120 pieces p.h.



To right in circle: Finish boring both holes of connecting rods on Ex-Cell-O Style 2112-A Precision Boring Machine. Production with this simple set-up is 137 pieces p.h.

To right: Standard Ex-Cell-O Style 1212-A Precision Boring Machine is a flexible machine tool for accurate boring, turning, facing and similar work at production rates that keep unit costs down. For specifications write for Bulletin No. 31101.

Modern machine tools mean, "more goods for more people at lower prices" . . . see 1947 Machine Tool Show in Chicago in September!

For instance: Two connecting rods per minute are rough bored, grooved and chamfered on the standard Ex-Cell-O 1212-A Precision Boring Machine illustrated in circle A to the left. After these operations the rods go on an Ex-Cell-O Style 2112-A Single End Precision Boring Machine for finish boring both holes. Circle B is a close-up view of the tooling on this machine. These methods of machining connecting rods are examples of good production with *comparatively simple tooling* on standard machines. When extremely high production is required, as with automotive connecting rods, larger Ex-Cell-O machines carrying more spindles are used, and parts are hydraulically located and clamped. On the other hand, when production requirements are lower, methods can be further simplified and tooling costs held to a minimum. *If you have a machining problem where accuracy, production and economy are essential, get in touch with* EX-CELL-O.

XLO
EX-CELL-O for PRECISION

47—4

EX-CELL-O CORPORATION

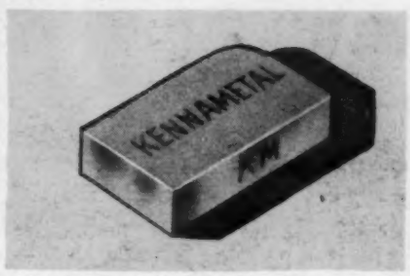
DETROIT 6
MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS AND CUTTING TOOLS • PRODUCTION PARTS AND SUB-ASSEMBLIES

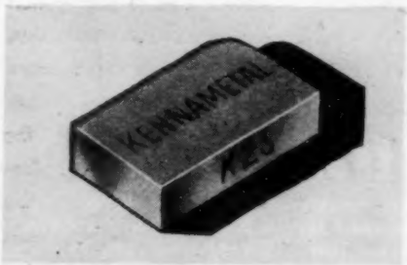
IT PAYS TO KNOW *Your* KENNAMETAL GRADES!

Most crater-resistant Kennametal tool material—gives outstanding service for finishing or moderate cuts on carbon and alloy steels .30% carbon and higher. Also time-and money-saver for general use on soft steels containing less than .30% carbon, precision boring of steel where .004" feed or over is used, and for many milling jobs on steel. 92 Rockwell A hardness.

The hardest Kennametal tool material grade — specifically for solid tools used on precision boring of steel parts. Its high hardness, great resistance to cratering, and unusual strength can help you cut costs where fast, accurate work is essential. 93.2 Rockwell A hardness.

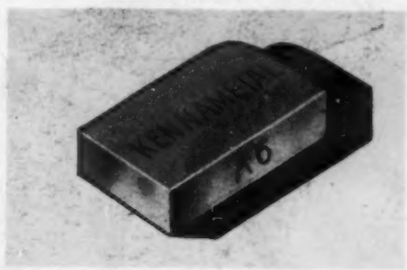


Strongest crater-resistant Kennametal tool material—saves tooling and production costs when taking rough cuts on carbon and alloy steel forgings, bar stock, etc., having carbon content of .30% and higher. Also outstanding for milling of steel at heavy chip loads. 91 Rockwell A hardness.



A very strong Kennametal tool material, particularly suitable for roughing cuts on steel castings. Its high resistance to abrasion and edge wear of sand inclusions makes possible exceptionally high rate production, and economical tooling costs. 91.5 Rockwell A hardness.

Highly resistant to edge wear—takes a good edge—a money-saving tool material for very light finishing cuts on steel and for precision boring with less than .004" feed. Ideally suited for tools requiring large nose radius or where tool must dwell without cutting. Excellent for milling, and very rough cutting of brass, bronze, and aluminum alloys. 92.3 Rockwell A hardness.



Reduces cost of machining cast iron. Extremely hard, straight tungsten carbide tool material having unusual strength. Holds keen edge, withstanding shock of interrupted cuts on rough, sandy, or chilled castings. Also outstanding for finishing and precision boring of cast iron. 92.2 Rockwell A hardness.

KENNAMETAL Blanks are now sold in *Economical* "Package Lots."
For Prices and Particulars Send for Catalog 46

KENNAMETAL
SUPERIOR CEMENTED CARBIDES
KENNAMETAL *Inc.*, LATROBE, PA.

PRODUCTION *Accessories to Lower* COSTS

THREAD TOOL

Mounts on any screw cutting lathe and replaces single point thread tools and chasers. Indexing system presents each of ten cutter teeth successively to the work allowing maximum cuts to produce a perfectly formed thread. Duplicates threads without gauging. Write for Bulletin 110.

LOCKJAW

New all purpose work clamp eliminates expensive bolting operations on millers, planers, grinders and drills. Stops work heaving, shimmying, yawing and buckling with sure-grip, locking pressure forward and downward. Write for Bulletin 140.

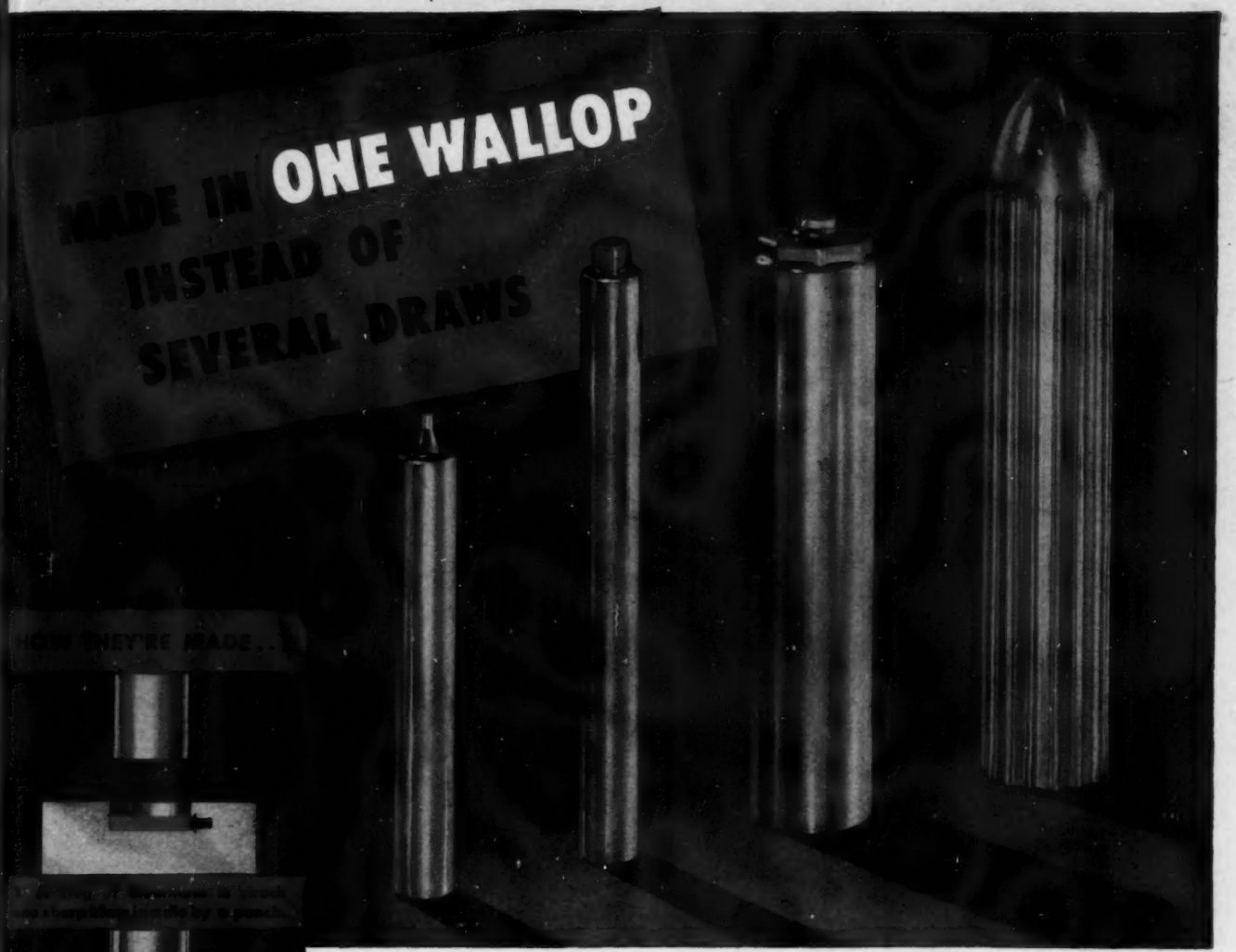
COLLETS

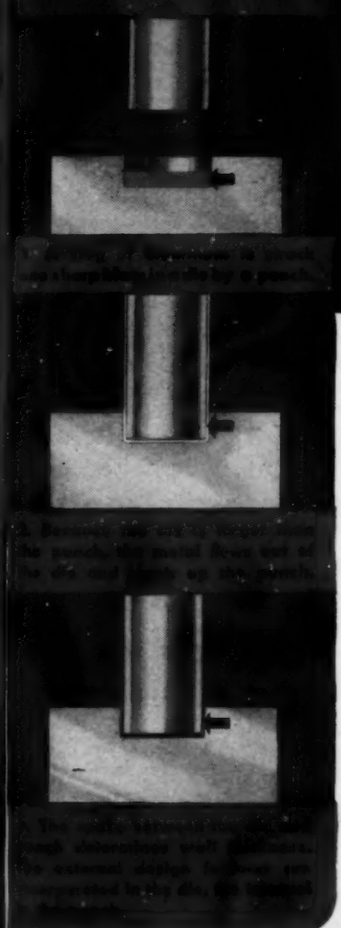
Lathes, milling machines and other tools can readily be equipped to use Rivett draw-in collets and step chucks. This self-centering, convenient method of chucking reduces time and increases precision on tool-room and production work. Write for Bulletin 100.

RIVETT

RIVETT LATHE & GRINDER, Inc.

BRIGHTON • BOSTON • MASS. • U. S. A.





They're ALCOA Impact Extrusions

These parts show you four of the many special designs that can be made by the impact extrusion process. In the wink of an eye a slug of Alcoa Aluminum is walloped once—impact-extruded—to form the bodies of each of these parts. Then minor flanging and threading operations complete the jobs.

Almost any symmetrical shell —round, oval, or square—can be made quicker, with much greater leeway in special design features, and at lower cost by the impact extrusion process.

ALUMINUM COMPANY OF AMERICA, 2107 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in leading cities.

MORE people want MORE aluminum for MORE uses than ever

ALCOA FIRST IN ALUMINUM

IN EVERY COMMERCIAL FORM

Avey Automatic METHOD No. 6

THE Avey CAM FEED UNIT

No. 1 Size—1/2" capacity in cast iron.

No. 2 Size—7/8" capacity in cast iron.

Designed for multiple operations on angular holes — drilling, reaming, counter-boring and tapping at one clamping of work.

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THE AVEY DRILLING MACHINE CO.
CINCINNATI • OHIO • U. S. A.

Accelerated production obtainable by free loading time, and multiple operations obtained in time of longest single operation — machine automatic index as a pace-setter.

METHOD No. 6 — higher production, lower cost per piece, greater accuracy—(no re-loading)—fatigue at a minimum by semi-skilled operators with minimum supervision.

It's a Radar Part

Assembly is illustrated full scale. Brass screws and nuts bolt the flanges; brass terminal fittings hold the shielded leads; and because the base metal is copper, the cadmium plating is on to stay.

...but how to make it?

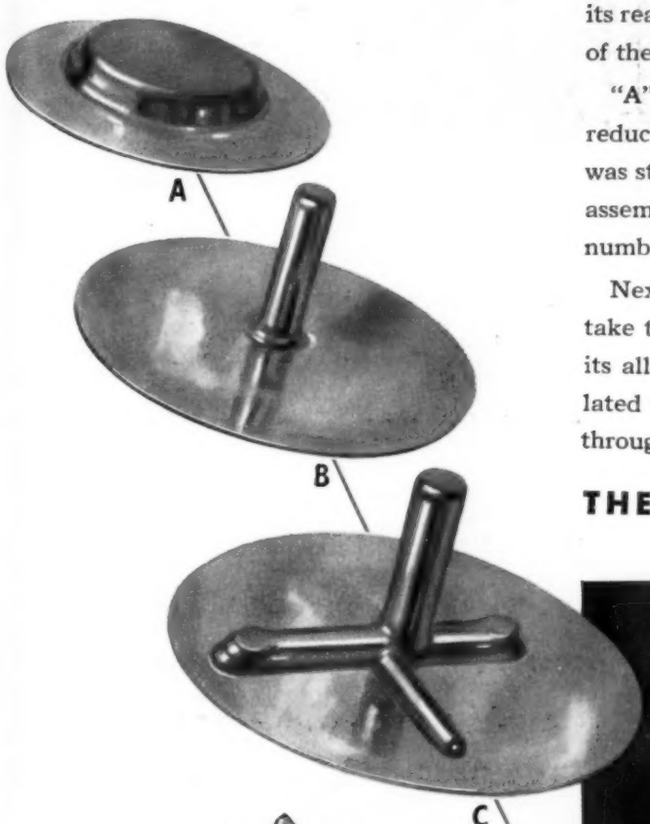
To the Guyer Metal Products Corp., of Chicago, Ill., the answer was simple . . . or relatively so, considering the complexity of the housing and the close dimensional tolerances required.

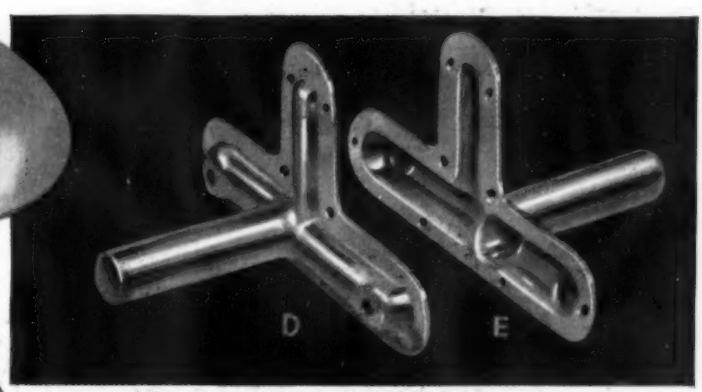
Anaconda Electrolytic Copper strip was used because of its ready adaptibility to cold working and the accurate gage of the metal furnished.

"A" shows the first blank and draw operation. A series of reducing operations resulted in "B". Next, the body, "C" was stamped—and this part was used for *both* halves of the assembly, "D" and "E", with variations in the form and the number of perforations.

Next time you meet up with a problem in metal forming, take time out to consider; 1: the versatility of copper and its alloys, brass, bronze and nickel silver; 2: the accumulated wealth of metal-working experience available to you through our Technical Department.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut

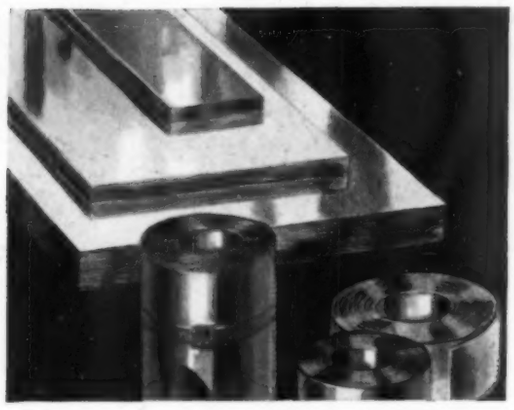


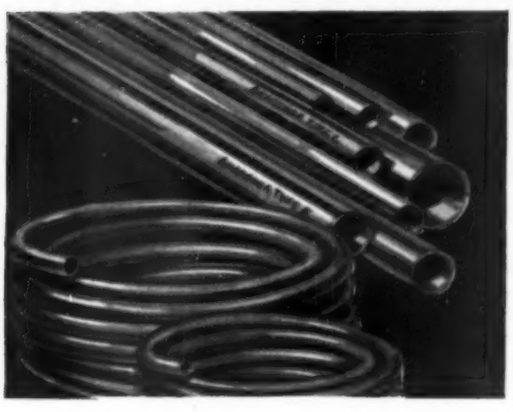


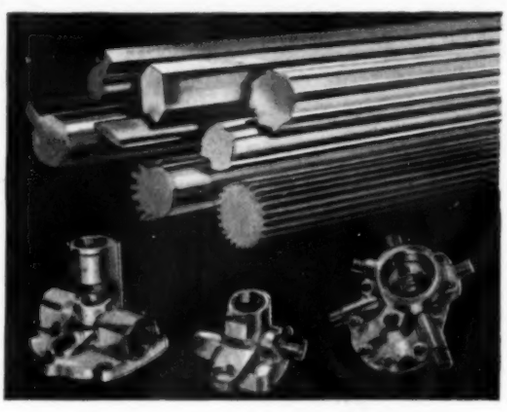
ANACONDA
from mine to consumer

Anaconda
COPPER AND BRASS

947







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OF ALL COMMERCIAL METALS

And today, through modern metallurgy, that age-old versatility of copper alloys is enhanced in several ways... by combining a number of desirable properties in a single alloy... by widening the choice of materials for ordinary and specialized uses... by assuring products that give unexcelled performance under a wide variety of service.

The American Brass Company produces Anaconda Copper and Copper Alloys in practically all commercial forms; also in special shapes and die pressed forgings. Whether your requirements are large or small, the personnel of Company Warehouses, District Offices and Anaconda Distributors will be glad to serve you. 47115

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

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ANACONDA

Anaconda **COPPER and BRASS**

a Significant *Announcement...*

2 NEW

TIME AND MONEY SAVING

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TANGENT CHASER DIE HEADS

Chasers and chaser holding blocks quickly replaced *without losing size adjustment*

The NEW MURCHEY "TRB" Rotating or the "TLB" Stationary Die Head, with extra chasers and blocks preset to exact location in the Murchey fixture, *takes the place of two or more complete tools.*

Down time is reduced to a minimum—replacement of chasers and holding blocks is usually made *without removing tool from the machine.*

Chasers of a given pitch may be used to cut any diameter thread within capacity of the head.

No special equipment is required for close-to-the shoulder threading.

Longer chaser life is assured. Chasers are merely cleaned up on cutting edge—do not have to be ground to a predetermined point when sharpened.

A joint statement
SHEFFIELD* and *MURCHEY:

Present and prospective users of Murchey products are assured of

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product and sales service of the Murchey line of products

AVAILABILITY
of Murchey replacement parts

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of Murchey products through research.

Contact your nearest MURCHEY REPRESENTATIVE on your current threading problems and ask for copy of new MURCHEY catalog—or write direct

MURCHEY MACHINE & TOOL CO.
Detroit 26, Mich.

MURCHEY

DIVISION OF THE SHEFFIELD CORP.
DAYTON 1, OHIO, U.S.A.

2698

Simplified TOOL ROOM AND PRODUCTION GRINDING

with Adaptable Nos. 2, 3, 4 Universals

Complete equipment furnished for cylindrical, shoulder, taper, angle, face and internal grinding with provision for compound settings for combination straight and taper (or double taper) grinding with only one set-up.

Grinding parallel and angular surfaces at one setting . . . a time-saving method shown in the illustration. The wheel slide is set at the angle of the angular surface and the axis of the wheel spindle is parallel to the table ways. The angular surface is ground by cross slide movement and the parallel diameter by longitudinal table travel, assuring concentricity between the two ground surfaces.

SIMPLE . . . QUICK TO SET UP . . . EASY TO OPERATE

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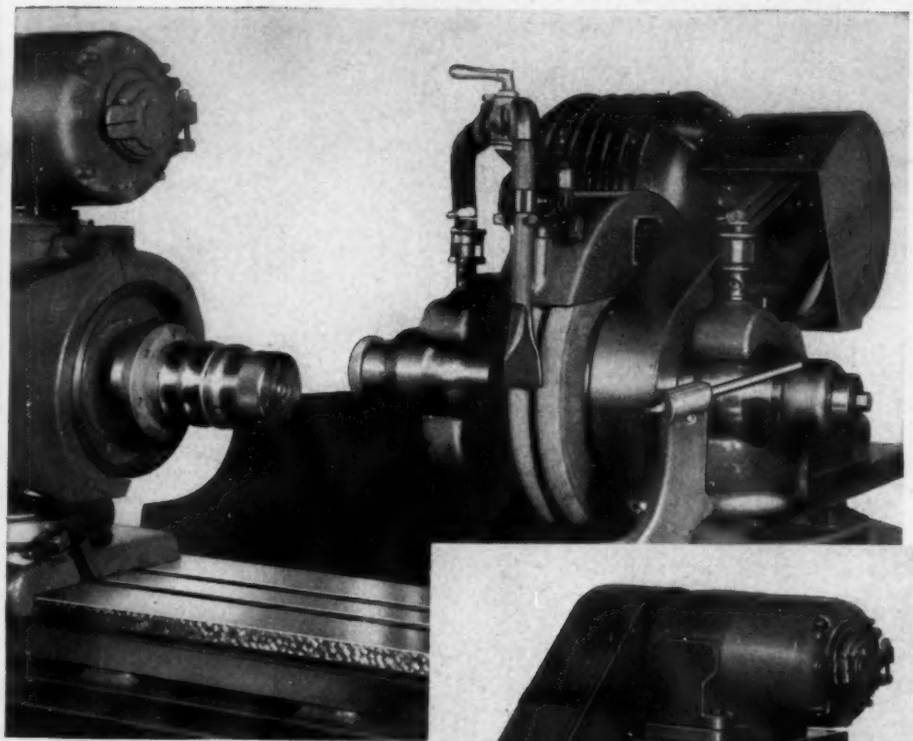
plus BROADER USEFULNESS

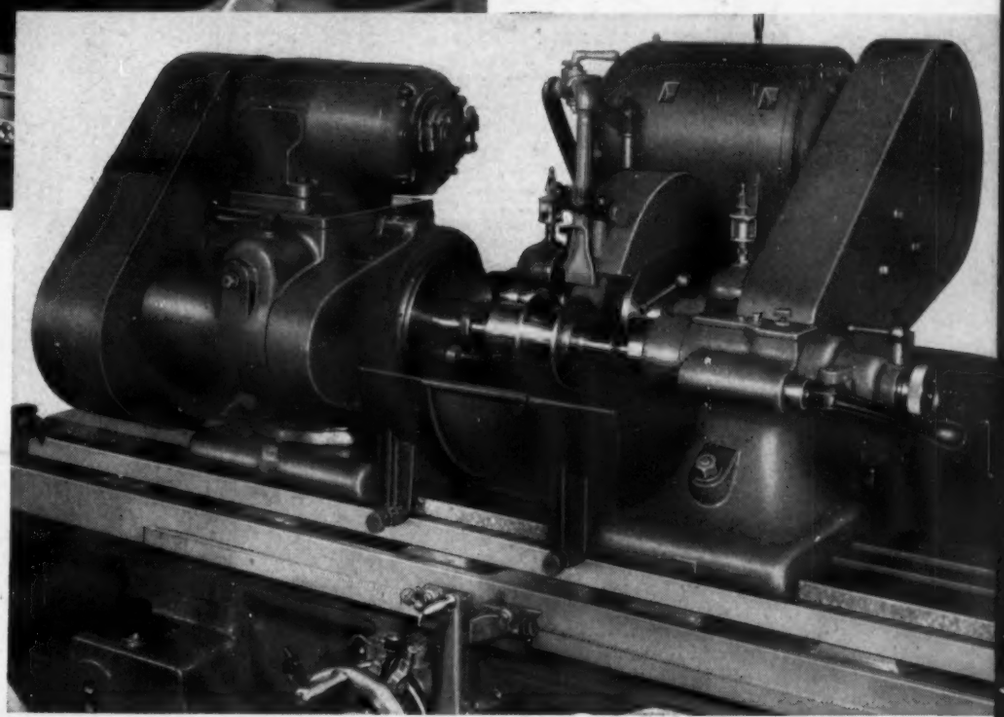
. . . THROUGH EQUIPMENT DESIGNED FOR SPECIFIC PURPOSES



● Greater production on many different grinding operations is easily obtained on the versatile Nos. 2, 3, 4 Universal by the addition of special equipment. Typical possibilities are illustrated for *form grinding*. They have proven highly *profitable* and *efficient*.

●

◀ **Form grinding both inner races** *of a double ball bearing with one set-up. A special work holder is mounted on the spindle of the plain-bearing, revolving spindle headstock.*



Form grinding ball bearing inner race ▶ *held on an expanding bushing and driven on dead centers. The large stock removal requires a 5 H.P. motor, driving to the end of the spindle.*

●

Nos. 2, 3, and 4 Universal Grinding Machines swing 14" diameter over table (12¾" diameter over water guards) and take 30", 40" or 60" length respectively. Complete literature gladly sent on request. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

& SHARPE

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GEARED to YOUR PRODUCTION SCHEDULE

Modern CLEVELAND FOUR POINT PRESSES

Although, in most instances, the wide range of standard sizes and capacities in which this popular line of Modern Four Point Presses can be furnished, is sufficiently large and varied to meet the needs of most Power Press users, our ability to furnish Modern Four Point Presses is not confined to standard machines and we are prepared to furnish Presses "engineered to YOUR specifications and geared to YOUR production".

Whatever you produce in the line of pressed metal products—whether large or small—you will find that the use of Modern Cleveland Single Point, Two Point or Four Point Presses will enable you to obtain greater efficiency, lower costs and more assured uniformity because Cleveland Presses are designed for accuracy of production and economy of operation.

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"If it's a Cleveland— it's Modern"

4-108-50D—Stroke 24", Adjustment 6", bed area 70"x108", capacity 500 tons.

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Chucking, hand, straight, spiral, boiler, stub, shell, taper, expansion . . . whatever type of reamer the job calls for, Union can supply it. Union Reamers, and all the tools in the complete Union line, are built to deliver tool-saving, time-saving, production-improving service, accuracy and efficiency on every metalworking job.

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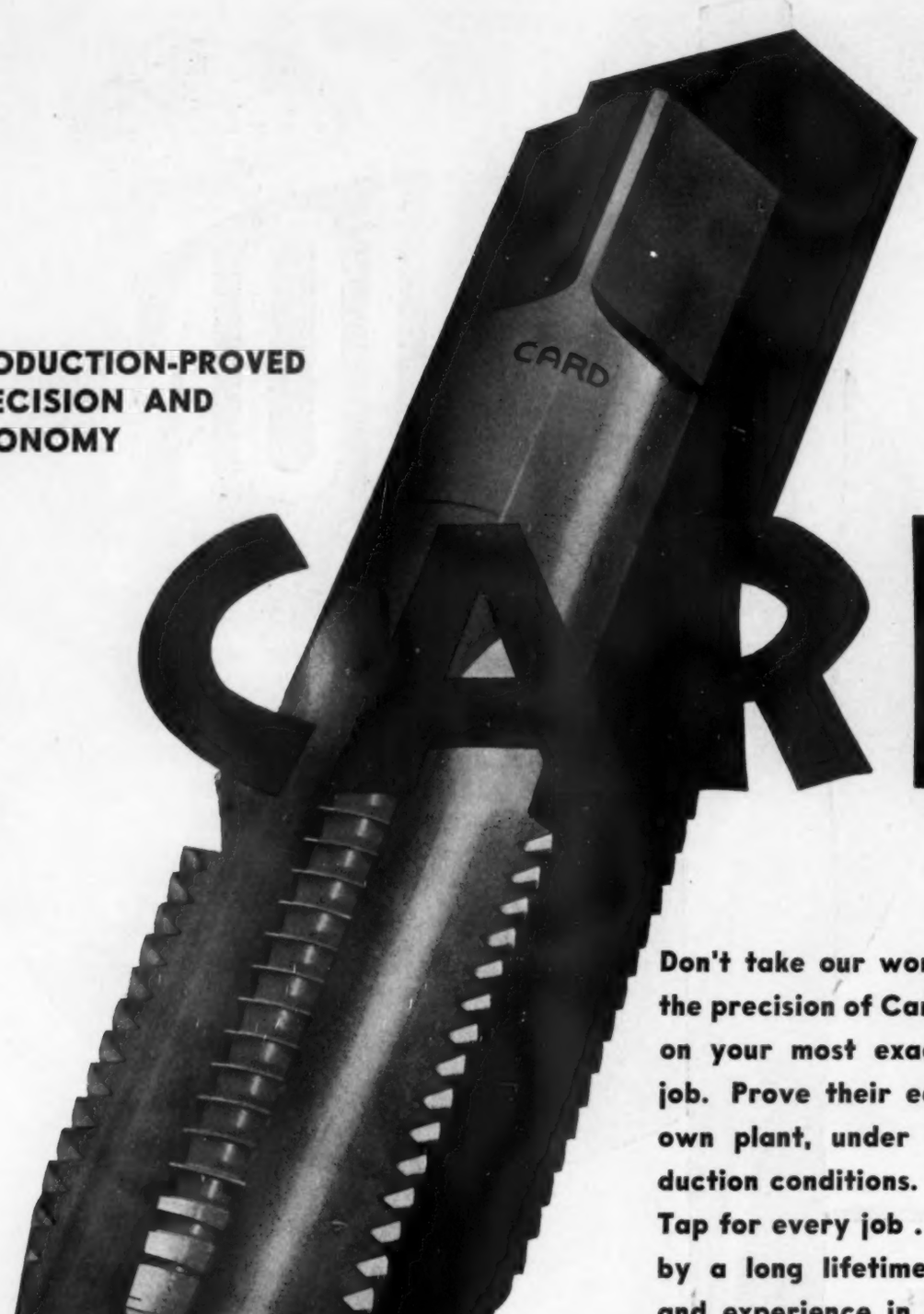

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Don't take our word for it. Prove the precision of Card Taps yourself on your most exacting threading job. Prove their economy in your own plant, under your own production conditions. There's a Card Tap for every job . . . each backed by a long lifetime of knowledge and experience in every phase of tap design and tap use.

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Butterfield

When you want the "one best" reamer for the job . . . choose Butterfields. Whatever the work, the material, the output required, the tolerances, you can choose Butterfields and be sure of results that are right—in performance, in precision, and in price.

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EYE BOLTS

They'll carry the load

Specify ARMSTRONG Drop Forged EYE BOLTS for extra strength — correctly engineered proportions, forged-in quality, uniformity of design in all sizes, and the best mild steel, heat treated to increase tensile strength.

ARMSTRONG Drop Forged EYE BOLTS as built to tool standards, are not hammered out in "tonnage forgings". They come in plain or shoulder patterns, blank or threaded, in 14 sizes, shank diameter from ¼" to 1½", inside diameter of eye ¾" to 2½". They will always carry their rated load safely.

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"The Tool Holder People"
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If there was ever a place to get *better* Small Gears, *this is it!* . . and for very good reasons, too. Throughout a quarter century of intensive specialization . . years of constant research and progress . . we've developed the art of engineering and producing Fractional Horsepower Gears to a degree of perfection generally considered impossible a short time ago.

When you specify "G.S." for instance, you employ extensive facilities and an experienced organization of Small Gear Craftsmen. They can lend you valuable aid, not only in turning out *uniform* production runs, but also in establishing the *one* best design for the job the gear has to do. So . . whatever the problem . . put it up to a G.S. Engineer! Let him help you achieve the finest performance you've ever known from a Fractional Horsepower Gear! Ideas, information and cost estimates are yours for the asking. Will you write or phone us today?

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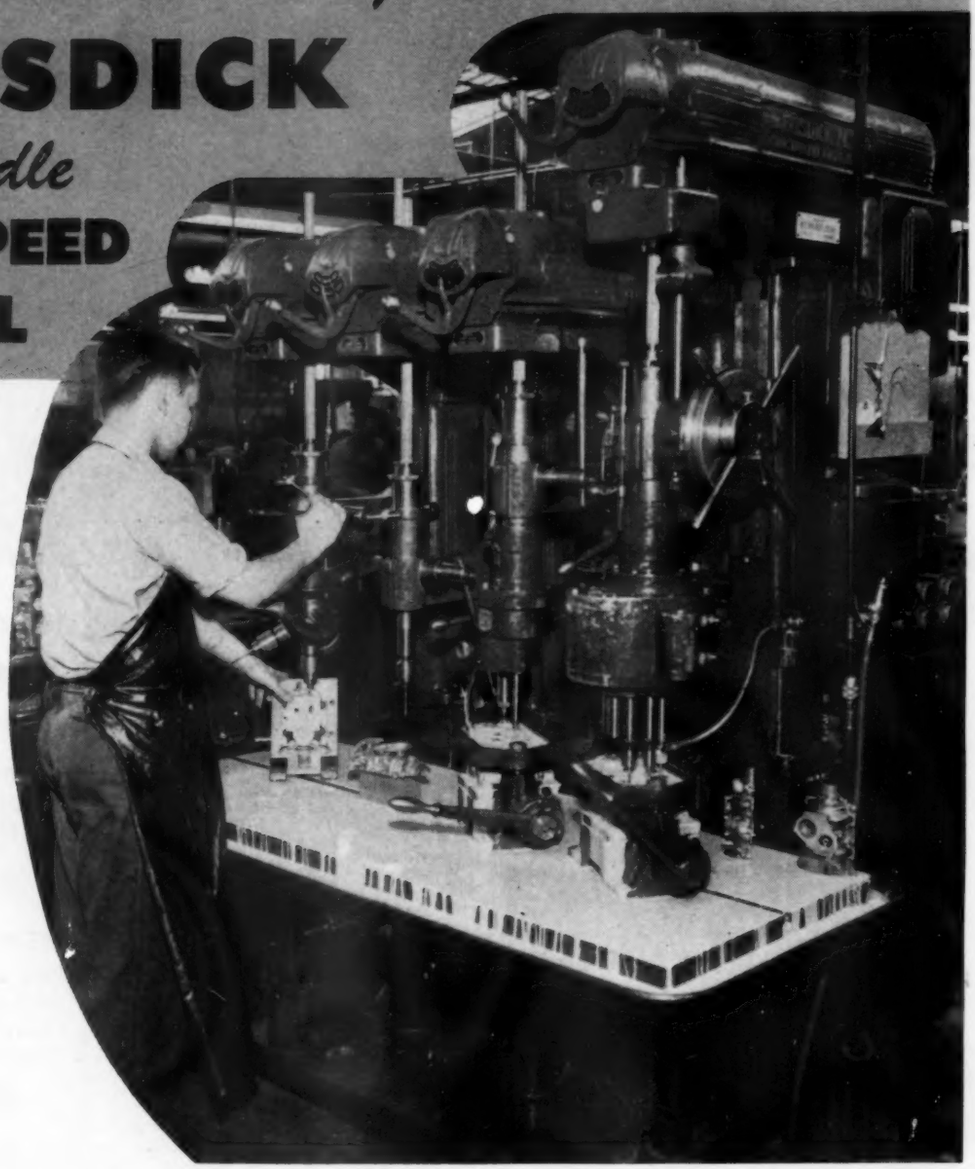
WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS

Small holes drilled, reamed, tapped, fast--accurately--at low cost

on FOSDICK *4 Spindle* HIGH SPEED DRILL



● Here is a typical Fosdick 4-Spindle High Speed Drill installation showing the application of this machine to high producton work.

Two of the spindles are equipped with multiple drill heads —one spindle is used for tapping—while the fourth spindle is equipped with turret head. The use of fixtures facilitate locating holes in work and enables operator to produce more work—faster.

These machines are furnished with any number of spindles from one to six. There are six spindle speeds ranging from 110 to 1800 and special ranges can be supplied if desired. To provide a reverse to the spindle for tapping, an additional contactor is added to the controller.

Mechanically simple—sturdily built—ball bearing anti-friction type construction—these machines are being used extensively in shops requiring high speed, low cost production.

Full details available in our High Speed Drill Bulletin H.S A.

THE *Fosdick* MACHINE TOOL COMPANY
CINCINNATI 23, OHIO

5 BILLION MOTOR HOURS

PROVE YOU CAN'T BEAT

TRI/CLAD EXTRA PROTECTION

Announcement of the Tri-Clad motor, back in 1940, ushered in a new concept of general-purpose motor design. Substantially increased horsepower-per-frame-size was one feature. Smarter appearance was another. But what really sold more than a million Tri-Clad motors is the *extra protection* we built into them. Figured conservatively, they have delivered more than 5 billion hours of service.

Today, with the "family" including dripproof motors, vertical motors, gear-motors, capacitor-motors, and totally enclosed motors, the Tri-Clad motor is, more than ever, the motor that means basic protection, dependable performance, and minimum upkeep. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

EXTRA PROTECTION . . . AGAINST PHYSICAL DAMAGE!

Rigid cast-iron frame and end shields protect vital parts from external abuse and prevent resonance. Because they're not at the mercy of a coat of paint, they strongly resist chemical attack and dampness. Cast iron also gives you tight, *metal-to-metal* fits between end shields and frame.

EXTRA PROTECTION . . . AGAINST ELECTRICAL BREAKDOWN!

Windings of Formex* wire, together with improved insulating materials, reduce the chances of electrical failure. Heat is dissipated quickly —motor stays young for years and years.

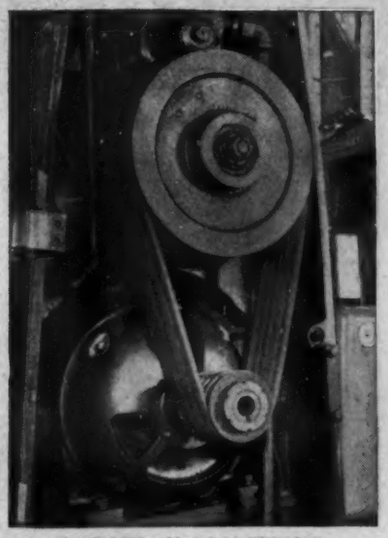
EXTRA PROTECTION . . . AGAINST OPERATING WEAR AND TEAR!

Bearing design affords longer life, greater capacity, improved lubrication features. Bearing seals retain lubricant, keep out dirt. One-piece, cast-aluminum rotor is practically indestructible.

**Trade-mark reg. U.S. Pat. Off.*

GENERAL ELECTRIC

750-286C



5 YEARS IN "SOLITARY"

Many machine tools in the Bell Aircraft plant at Buffalo have pioneer Tri-Clad motors tucked away inside. The result is a sleek exterior for the machine and valuable floor space saved. During the war, when time was short and uninterrupted protection was of utmost importance, these motors gave dependable service, demanding only a minimum of maintenance and inspection. The Tri-Clad motor you see here driving a milling machine has not been removed for five years. It has done its job faithfully despite the strain of a 3-shift, 7-day work schedule, and along with 200 other Tri-Clad motors in the Bell plant, gives every sign of staying on the job indefinitely.

NOW—PEAK MOTOR TOUGHNESS

The Tri-Clad totally enclosed, fan-cooled motor is designed for use in adverse atmospheres — in iron dust, out-of-doors, in hazardous areas, and chemical atmospheres. It gives you these important construction features:

- A cast-iron, double-wall frame which completely encloses and protects windings and punchings.
- A nonshrinking compound around motor leads which protects motor interior from dust and moisture.
- A rotating labyrinth seal which further protects the motor interior from damage by foreign matter.

TRI/CLAD

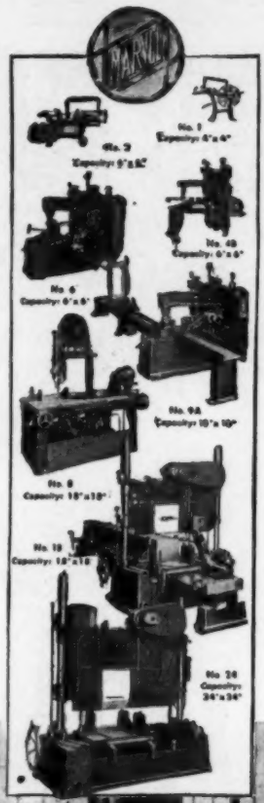
REG. U.S. PAT. OFF.

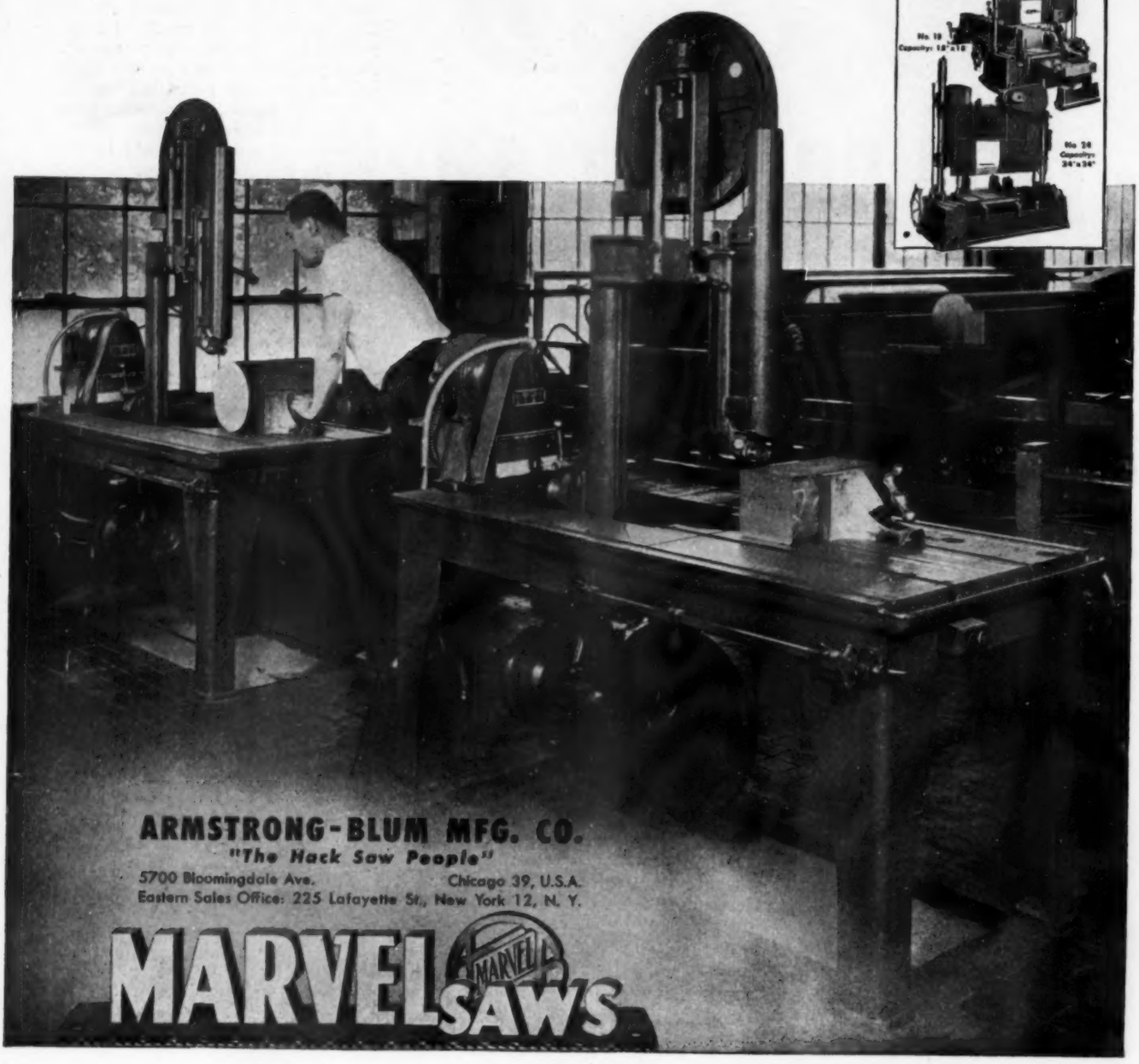
MOTORS

Latrobe Electric Steel Warehouses MARVEL No.8 Band Saws are Used

Not only in all Latrobe warehouses but at the mill too, MARVEL No. 8 metal-cutting Band Saws are used to cut expensive Tool and Alloy Steels accurately to specification. There are many reasons why the Latrobe Electric Steel Co. has standardized on the universal MARVEL No. 8. It is the most universal saw built—will cut the smallest pieces as well as the largest work up to 18" x 18" with equal accuracy, will cut at any angle, etc. . . . and, is easily operated and practically trouble-proof.

There is a MARVEL Saw for every need and budget. A local MARVEL Field Engineer will gladly discuss your problem with you, recommend the most suitable saw and demonstrate a MARVEL Saw in your vicinity. Consult your classified phone book or write us for address of nearest MARVEL Field Engineer.





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"The Hack Saw People"
5700 Bloomingdale Ave. Chicago 39, U.S.A.
Eastern Sales Office: 225 Lafayette St., New York 12, N. Y.

MARVEL SAWS

Baush "W" Type machines are especially adaptable for both flange drilling and rectangular hole layouts. Available in 3 sizes, shown in specifications, with adjustable arms to handle drilling of hole centers that constantly vary—or with master-bored cluster plate having spindles in fixed pattern to fit one operation. Horsepower capacities are graduated to cover predominant drilling operations.

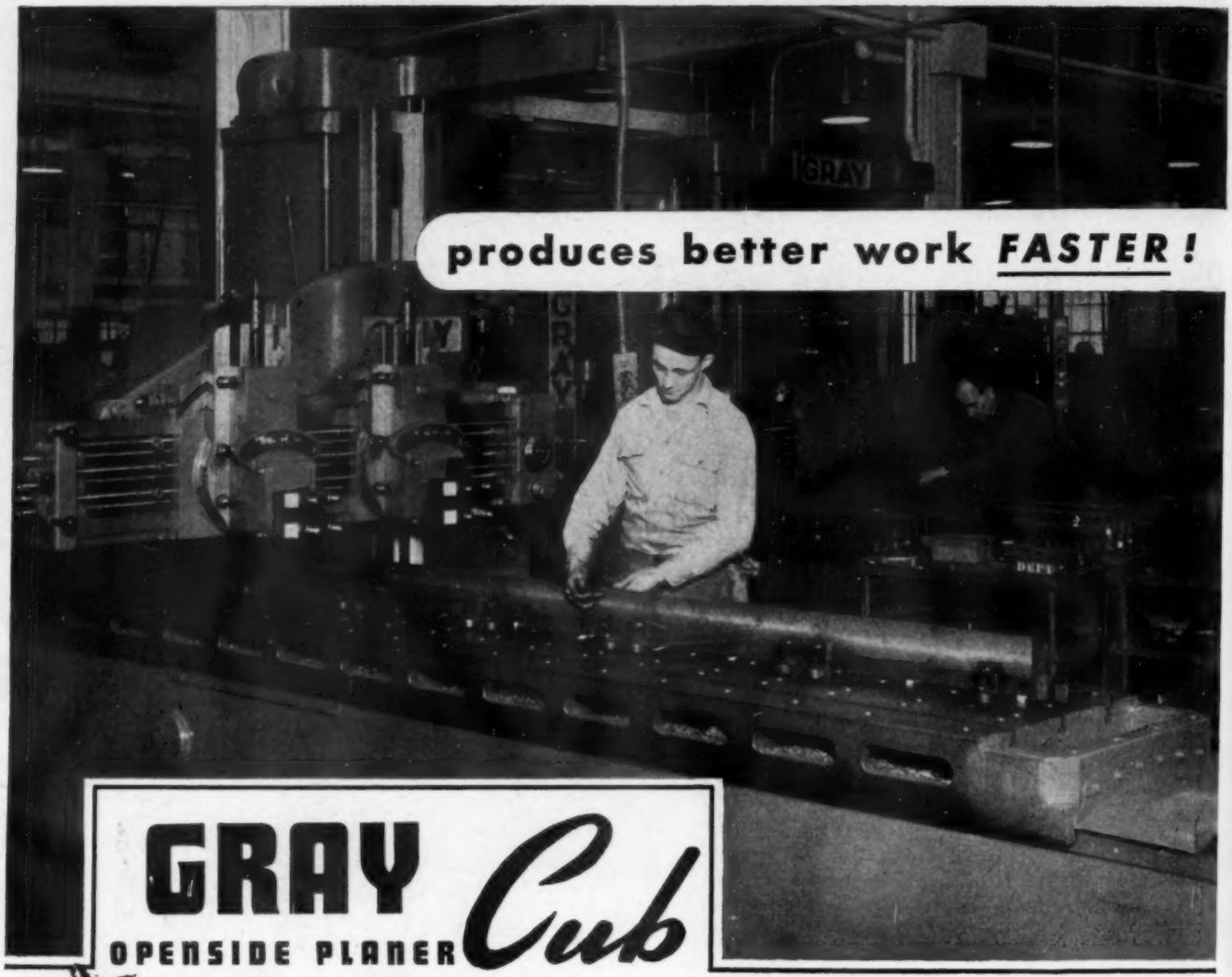
Spindle heads are of adjustable, joint driven type, with slip sleeve spindles that can be furnished in various standard sizes to meet work requirements. "W" Type machines are arranged for 18" maximum stroke of heads—adjustable feed rates—2 speed geared yokes and can be adapted for tapping. Either adjustable knee tables or box table can be supplied.

Also available in single way, 2-way or 3-way machines.

SPECIFICATIONS OF STANDARD W-TYPE MACHINES

	W-6	W-7	W-8
Maximum Horsepower Capacity for Spindle Drive	10 H.P.	20 H.P.	30 H.P.
Top of Base to Bottom of Head Flange, Head up	60"	54"	50"
Max. Standard Stroke of Head	18"	18"	18"
Overall Height of Machine with low base	139"	141"	150"
Approx. Net Weight of Machine (Lbs.)	15,000	20,000	27,000
Head Sizes Available — Measurements taken between Spindle centers as follows: At Side, S. At Front, F.	18"S. x 24"F. 18"S. x 36"F. 24" round	20"S. x 30"F. 20"S. x 45"F. 32" round 36" round	20"S. x 30"F. 20"S. x 52"F. 32" round

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS



GRAY OPENSIDE PLANER Cub

"A Bear for Production"

1. The planer for Carbide Tools—cutting and return speeds up to 300′ per minute.
2. Speed of cut and return instantly adjustable from operating position.
3. Table started in either direction, reversed, "inched", or stopped from pendant switch.
4. Single-Shift power rapid traverse controlled at the heads or from either end of rail.
5. Space Saver Drive, with Full Floating drive Shaft.
6. Non-Metallic Table Ways eliminate scoring.
7. Loop Lubrication. The only adequate system for high speed reciprocating tables.
8. Mechanical non-shock tool lifters.
9. Side head feed independent of rail heads.
10. Built in 24″, 30″ and 36″ sizes.

DOUBLE HOUSING and OPENSIDE PLANERS
•
SWITCH PLANERS
•
DIE BLOCK PLANERS
•
MILLING PLANERS

PLANER TYPE MILLING MACHINES
•
HORIZONTAL BORING MACHINES

Write for fully illustrated descriptive Bulletin No. 55

The G.A. GRAY Co.

CINCINNATI 7, OHIO, U. S. A.

SOLD IN CANADA BY UPTON, BRADEEN AND JAMES, LTD. • SOLD IN LATIN AMERICA BY MACHINE AFFILIATES

The New Series KING

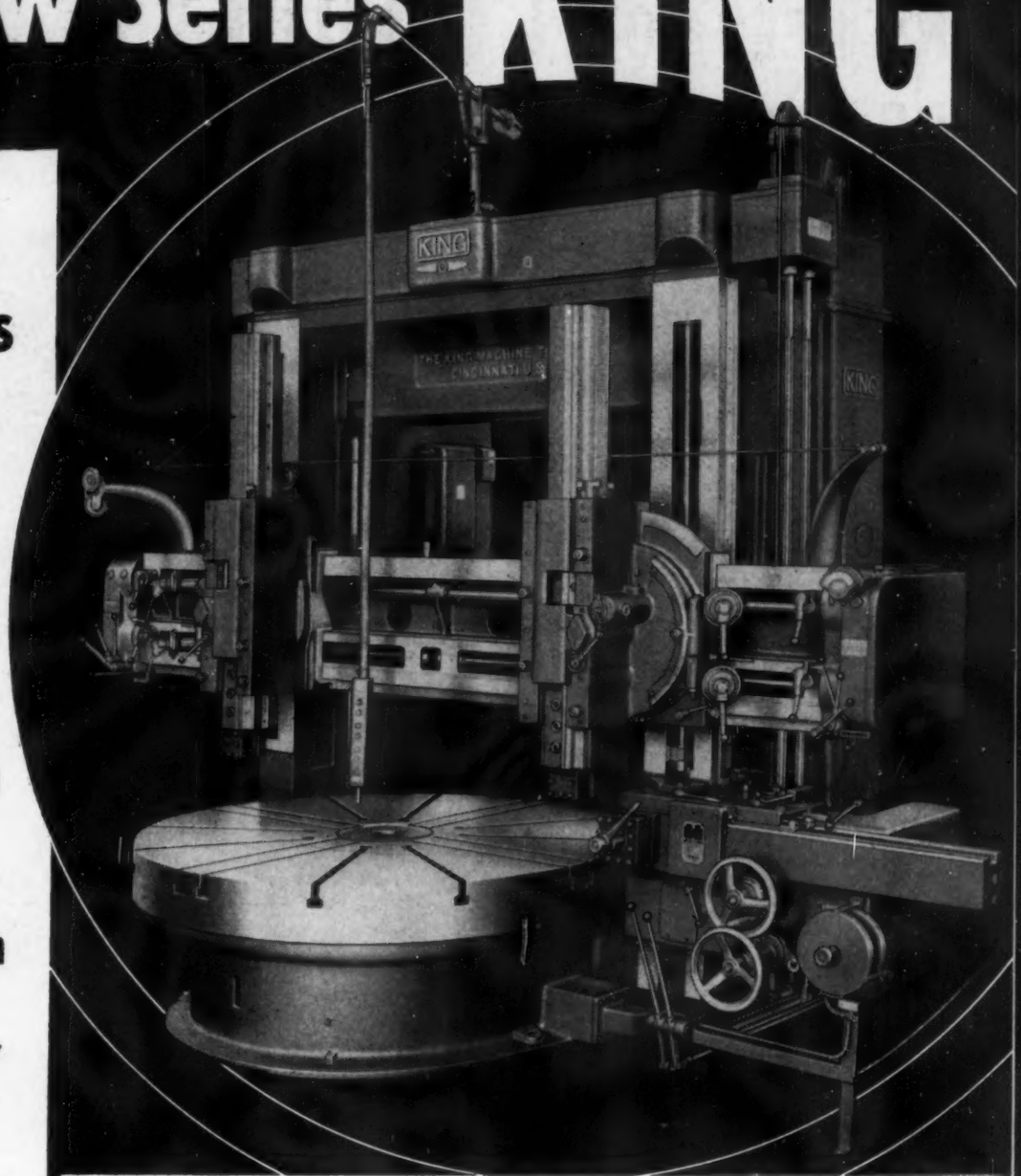
Furnished in ten sizes to meet every operating need

•

Single Column
30" 36" 42"

•

Double Column
52" 62" 72"
84" 100" 120"
and 144"



● Whether your work calls for boring—turning—facing or a combination of these operations, whether it requires the use of carbide tools, whether it's a small or a large job—there's a KING general purpose boring and turning machine that will handle it easier—faster—at lower cost.

They're Easy to Operate. Every single control lever is located to the front of the machine—readily accessible. Whether operator is changing feeds, table speeds, or making head adjustments he always has his controls within arms reach.

They're Accurate and Powerful. A substantial increase in weight plus new massive, rectangular type ram heads gives you the rigidity required for the successful use of carbide tools. Four *tapered* gibs and eight bearing surfaces provide adjustment for wear and assure high standards of accuracy.

For half a century KING Vertical Boring and Turning Machines have demonstrated their ability to give long service at consistantly low maintenance costs. The New Series KING with its increased weight and improved construction will meet your present day demands for greater power—speed—and accurate production. Investigate the New Series KING.

THE KING MACHINE TOOL COMPANY
CINCINNATI 29 OHIO
Builders of Vertical Boring and Turning Machines Exclusively

NO NEED TO "CODDLE" A ROBERTSON GRINDING WHEEL

NO MATTER WHAT your grinding problem may be, you can probably find half a dozen wheels that will produce satisfactory results—if you can afford to spend the time and effort to "coddle" them.

But that's expensive.

Much better results can be obtained by discussing your grinding needs with a Robertson Sales Engineer who will help you select the most suitable wheel for the job—a wheel that will produce the desired finish or take the necessary cut with the minimum of effort on the part of the operator.

Robertson wheels are made by precision methods for precision results, resulting in faster and more accurately-ground work. Experience has shown that many users reduce their tool-grinding costs, as a consequence, by as much as ten to twenty percent.

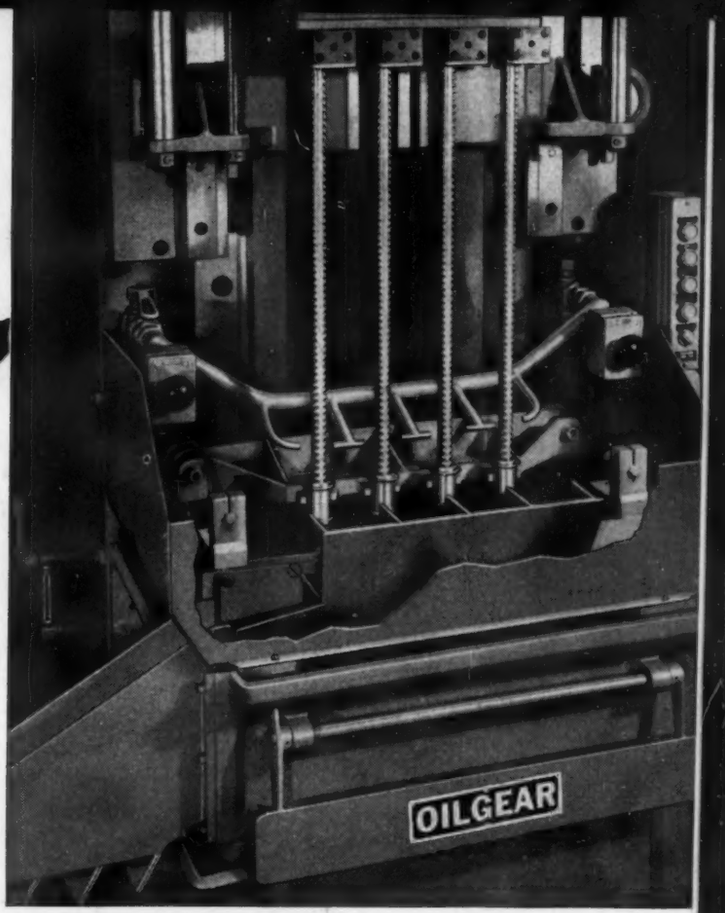
A copy of the booklet "How to Buy Production-Time" is yours for the asking. You will find it crammed with helpful, useful information prepared to help you make your Tool Room operations more efficient. Write for a copy.

ROBERTSON COOL-CUT

ROBERTSON MANUFACTURING COMPANY
TRENTON 5, NEW JERSEY

Manufacturers of Vitrified Grinding Wheels • Mounted Wheels • Segments

OILGEAR *Pull-Down* BROACHING



Broaching 3 splines in 630 Bicycle Coaster Brake Hub Shells per hour on an Oilgear Type XP-30 x 54" machine. Operator merely loads 4 parts and depresses start buttons. Multiple tool handling and ejection of parts are automatic.

SAVES TIME AND LABOR by freeing both hands of operator for loading work . . . by handling tools automatically . . . by threading and accurately centralizing work automatically . . . by broaching at speeds coinciding with operator's ability to serve machine.

SOLVES FINISH, ACCURACY AND PRODUCTION PROBLEMS by positive, pressure lubrication and cooling of tools and work . . . by causing chips to quickly fall away from tools and cutting zone . . . by securing tools at both ends during major portion of cutting stroke . . . by eliminating possible tool sag . . . by multiple operations per cycle . . . by more parts per grind and longer tool life . . . by controlled, higher broaching and return speeds. Unloading can be automatic. Loading, broaching and unloading can be performed without an operator.

See 21 large illustrations of broaching diversified parts . . . the time, labor and power-saving design and operational features and complete specifications on 10 standard Oilgear Pull-Down Broaching Machines as published in our new 24 page Bulletin 25000. Send the convenient coupon below for a free copy today. THE OILGEAR COMPANY, 1313 W. Bruce Street, Milwaukee 4, Wis.

Oilgear

Fluid Power BROACHING MACHINES

OILGEAR

MAIL COUPON FOR NEW 24 PAGE BULLETIN

The Oilgear Company,
1313 **W. Bruce St., Milwaukee 4, Wis.**

Please send me a free copy of Bulletin 25000 on Pull-Down Broaching Machines.

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DOES JOBS no other rotary power source can do!

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hydraulic motor

by GEROTOR

Sturdy axial thrust bearing
External or internal drain
Anti-friction shaft bearings
Basic Gerotor principle—low relative Gerotor speed
Outer Gerotor element in anti-friction bearing
Direct coupling drive or belt, chain or gear drive
Plain (shown), base or flange mounting

Converts hydraulic power into rotary power. Low rotational inertia permits infinite, rapid changes in shaft speed and direction. Can be stalled under load without damage—operated in explosive and corrosive atmospheres—installed in small, confined spaces.

Sizes up to 8.7 h.p. Write for further details.

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hydraulic motors • pumps • pump units • valves • cylinders

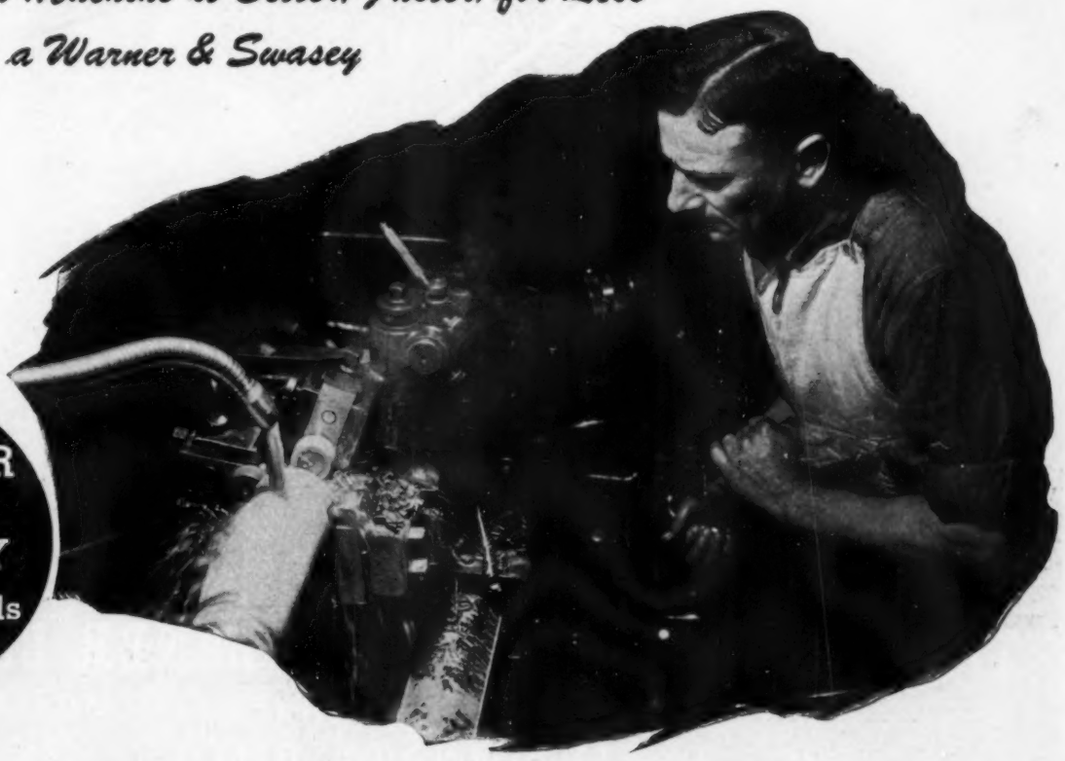
It's time to put the finger on *Profitless* production

WITH THE INEVITABLE return of competitive selling, manufacturers must avoid heavy inventories that have been produced at high unit cost. But how is this to be done while labor, material and overhead expenses continue at a high level?

One way is to allocate production costs to individual machine tools—make each responsible for maintaining a profitable operation by measuring its productive worth in *dollars*. Then, those machines which have lost their efficiency—can no longer produce fast enough to offset increased costs—can be quickly spotted.

A Warner & Swasey field engineer can aid in detecting machine tools that are no longer profitable producers. He can suggest ways of increasing their service value through new tools or accessories. Or if replacement is necessary, he can suggest the *correct* machine tool for your particular operation, so that

You Can Machine it Better, Faster, for Less
. . . with a Warner & Swasey

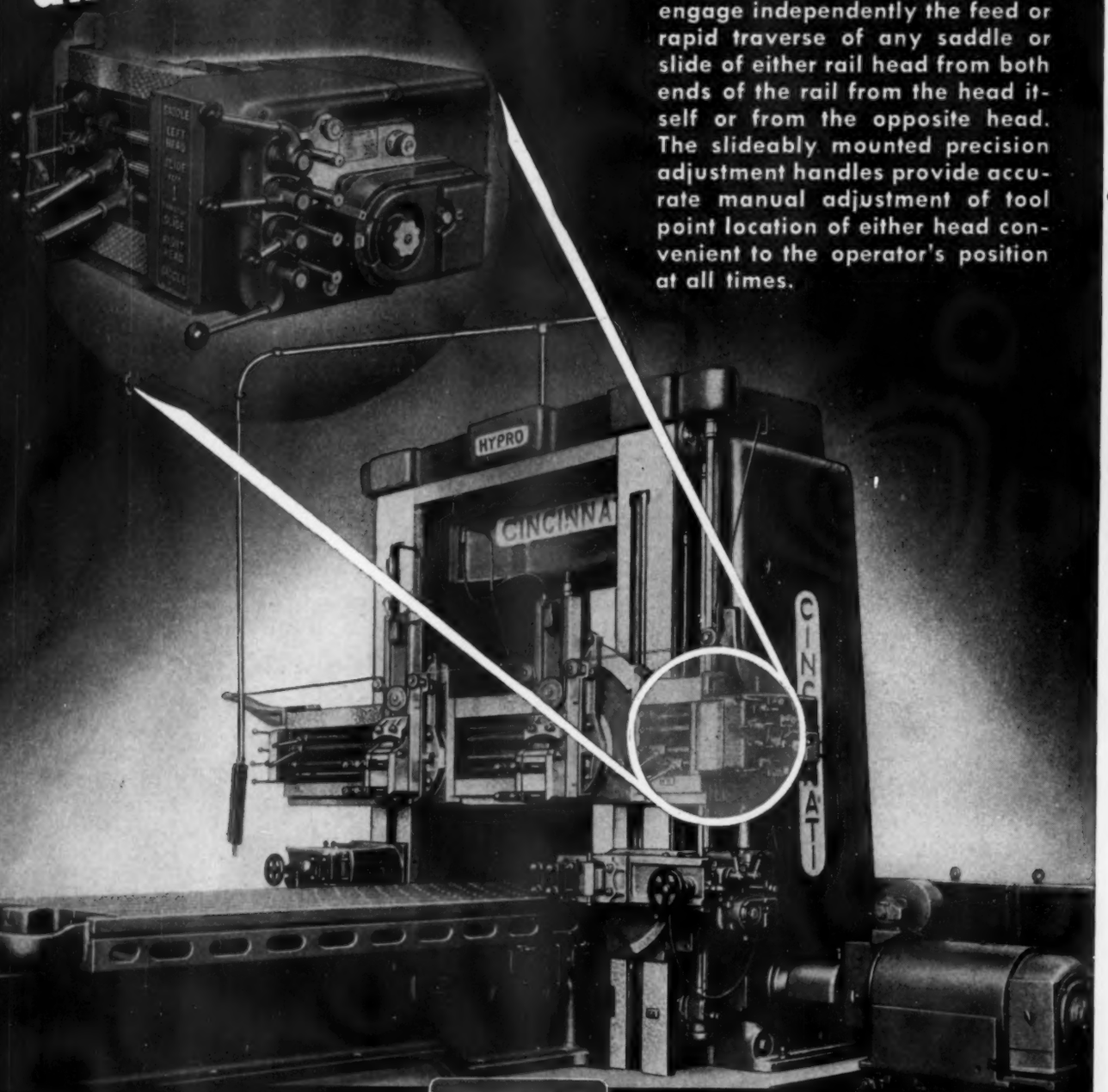


WARNER & SWASEY Machine Tools *Cleveland*

TURRET LATHES . . . MULTIPLE SPINDLE AUTOMATICS . . . PRECISION TAPPING AND THREADING MACHINE

NOW WITH THE NEW, MORE EFFICIENT CINCINNATI Hypro Dual Saddle Control and Precision Adjustment Handles

. . . it is possible to engage or disengage independently the feed or rapid traverse of any saddle or slide of either rail head from both ends of the rail from the head itself or from the opposite head. The slideably mounted precision adjustment handles provide accurate manual adjustment of tool point location of either head convenient to the operator's position at all times.



THE CINCINNATI HYPRO PLANER COMPANY

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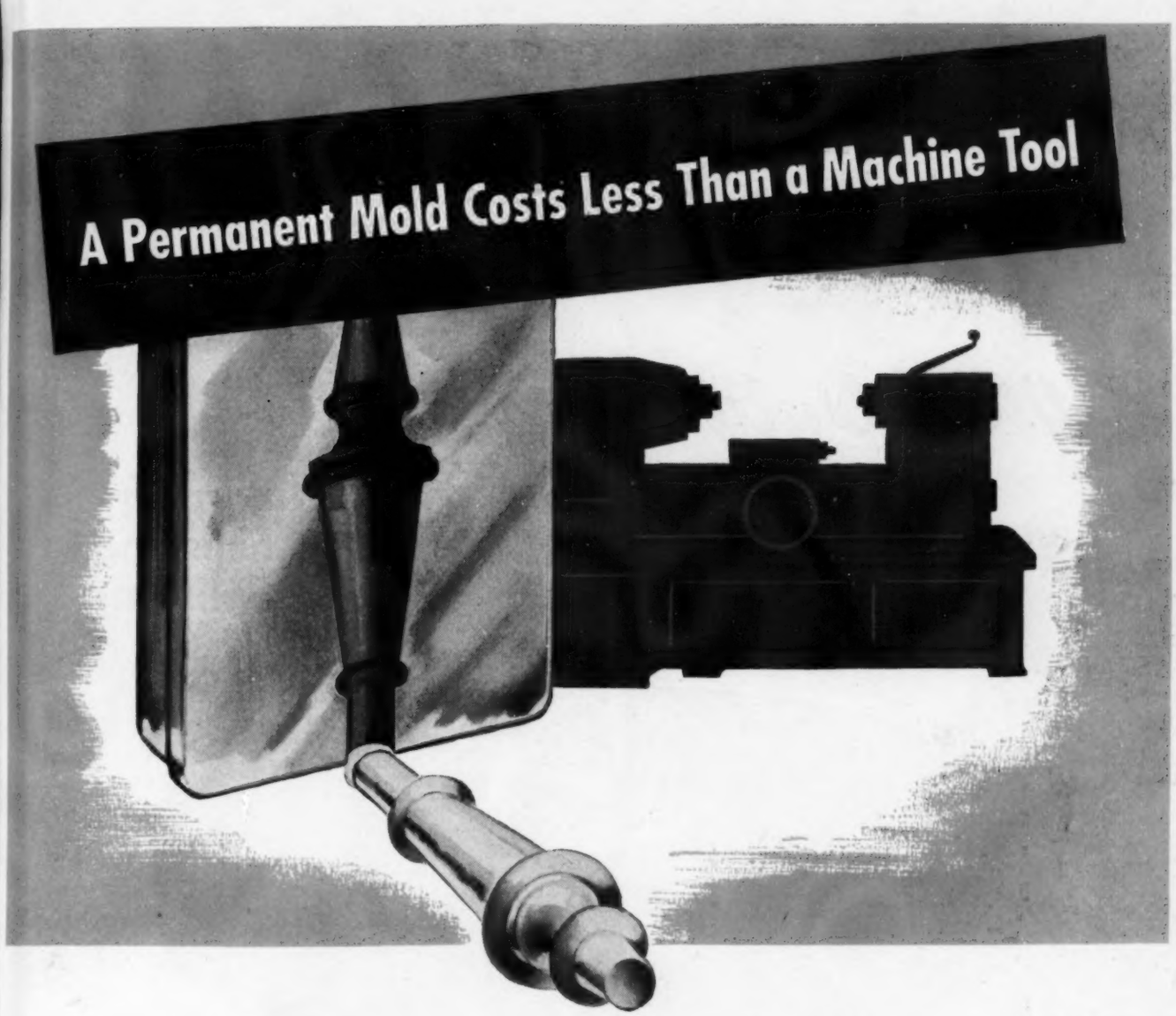
A Permanent Mold Costs Less Than a Machine Tool



And you get a BONUS in lightness!

Permanent-mold castings of American Magnesium do not require the time-consuming steps of rough machining, finish machining and finish grinding. Made to close limits, they eliminate the need for extra machine tools in your production line.

In addition, your product gains a bonus in lightness, for American Magnesium is 35% lighter than aluminum, 75% lighter than steel.

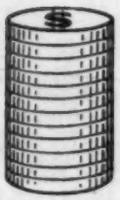
Give full consideration to the economies and the sales advantages offered by Permanent-Mold Castings of American Magnesium as you complete your designs. The 59 years of light-metal know-how of Aluminum Company of America will help you plan for their use. ALUMINUM COMPANY OF AMERICA, sales agent for American Magnesium products, 1709 Gulf Building, Pittsburgh 19, Pennsylvania.

MAGNESIUM MAZLO PRODUCTS

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA

Why Pay This Much.....



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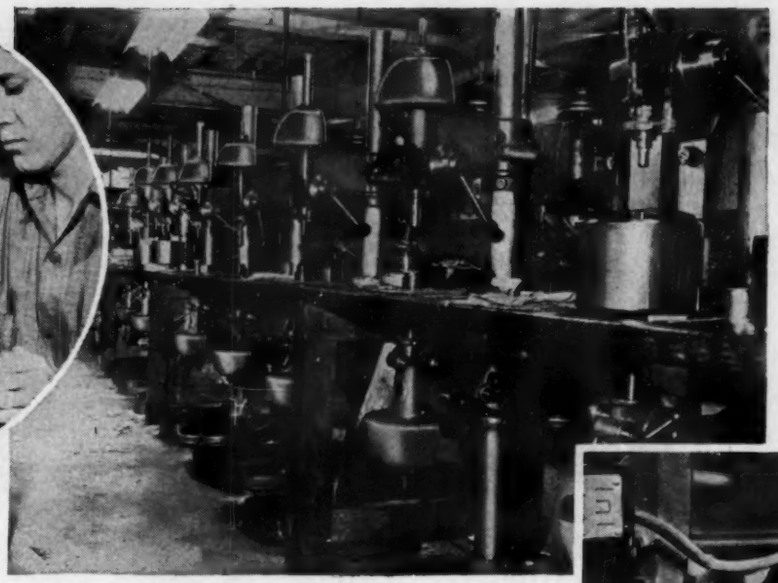
● In the unique action of Brightboy's abrasive-plus-rubber content, the abrasive burrs and finishes while the rubber cleans and polishes. Brightboy takes up where grinding abrasives leave off—bridges the gap between the grind and buff. Your abrasives stock isn't complete unless you have Brightboy wheels, sticks and hand tablets on your shelves—ready for the hundreds of uses to which this versatile abrasive can be put in the finishing of products in metals, plastics and wood. Ask your dealer for the Brightboy Catalog Manual and prices. Write us to have a Brightboy service man suggest methods and production short-cuts.

BRIGHTBOY INDUSTRIAL DIVISION, Weldon Roberts Rubber Co., Newark 7, N. J.

WELDON ROBERTS **Brightboy**

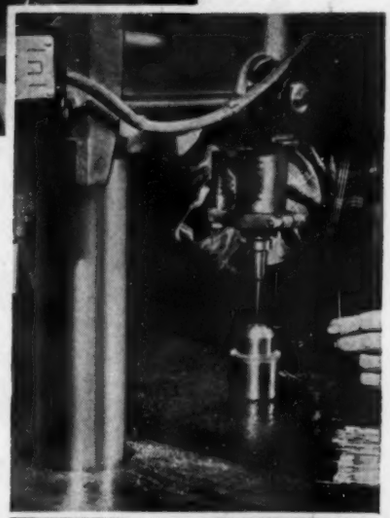
the* SOFT RUBBER BINDER CUSHIONS *the Abrasive

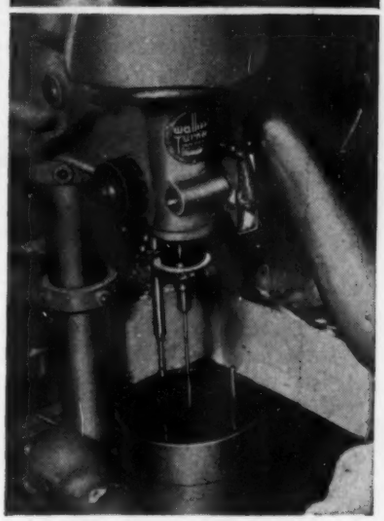
Turning with 15" Walker-Turner Drill Press.



A battery of twelve threading machines made up with two Walker-Turner drill heads on each column. Produce class #3 threads at very fast production.

Tapping with 15" Walker-Turner Drill Press.





Threading with Walker-Turner Drill Press.

"We Make Screw Machine Parts . . . . . with 30% Production Increase"

CHARLES MARTI

Charles Marti, manufacturer of precision screw machine products, has combined screw machine techniques with Walker-Turner 15" Drill Presses with remarkable results.

"We have 58 Walker-Turner Drill Presses in our plant, all used in the manufacture of small screw machine parts ordinarily made on Swiss Automatics. These parts range in size from 1/32" to 3/8" in diameter, 3/4" to 5" long and are held within .002 limits.

"Each machine performs a single operation. All machines are equipped with special turning fixtures which are adjustable to any size; twelve installations have two heads mounted on each column and do the work of threading machines. All tools and bushings are submerged in oil.

"With this method, we showed a 30% increase in production in the manufacture of needles for lettering pens as compared with the former screw machine method. All work is done by unskilled operators.

"We intend to continue using this method because it assures flexibility of operation, and is particularly economical in making short runs. New jobs do not require sets of cams, only resetting of tools."

CHARLES MARTI, *President*
Charles Marti Precision Screw Machine Products
Newark, N. J.

TWENTY-FIFTH YEAR
1922 1947

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DRILL PRESSES—HAND AND POWER FEED • RADIAL DRILLS • RADIAL SAWS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

Quick-Versatile
ROTARY MILLING & INDEXING

with KNIGHT'S 20" ROTARY TABLE

A SINGLE SELF-CONTAINED MOTOR-DRIVEN UNIT

- **Adapts any milling machine for power rotary milling and indexing work within a few moments.**
- **Setup time is virtually eliminated — just plug into nearest electric outlet for immediate operation. No other equipment or connections are required.**
- **Ample power is provided for almost any milling operation by a special geared-down motor.**
- **18 feed changes for 1½" to 54" per minute make adjustment to any cutting speed simple and quick. An optional feed range from 3" to 108" is available.**
- **In addition to indexing and rotary milling, the usefulness of the Rotary Table is further widened by its adaptability to many other jobs where an automatic revolving fixture would save time and costly manhours.**

Write for Descriptive Literature

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MACHINERY COMPANY

KNIGHT VERSATILE MILLERS ACCURATE RIGID

MORE GOODS for MORE PEOPLE at LOWER COST

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trap Dirt and Grit

These shaft-protecting bearings are equipped with thousands of grids filled with N-B-M Silver Babbitt. Destructive dirt and grit are caught in these tiny "traps" and safely embedded below the surface without affecting bearing performance.

Due to our new manufacturing processes, centrifugally-cast N-B-M gridded bearings are now available at "mass-production" savings. May we send you complete engineering data?

N B M

Brake Shoe

NATIONAL BEARING DIVISION
ST. LOUIS • NEW YORK

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Makes machine tools cut out the chatter

ELIMINATE "chatter" and you open the way for faster, more precise machining. Timken tapered roller bearings on spindles and at other points in your machine tools, do just that.

They assure a smooth flow of power from initial drive to spindle nose. Gears are kept in precise mesh and alignment. Spindle bearings may be preloaded to any desired degree—and they stay that way. The entire spindle assembly is rigid and free from vibration. These advantages pay off in faster operation; maximum accuracy; fewer rejected parts; reduced operating and maintenance costs; longer machine life.

Because the Timken bearing itself is a fine precision mechanism —a "Generated Unit Assembly"— made of Timken alloy steel, machine tools *retain* their precise, chatter-free performance even after many years of hard service.

Backed by 49 years of bearing research and development, Timken tapered roller bearings are first choice throughout all industry. Make sure you have Timken bearings in every machine you make or buy. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.

THE ATLAS PRESS COMPANY assures life-long precision in their bench lathes by mounting the spindles on Timken bearings. Atlas lathes are used for the accurate and economical machining of small parts in manufacturing plants of all kinds.

WE MAKE OUR OWN STEEL

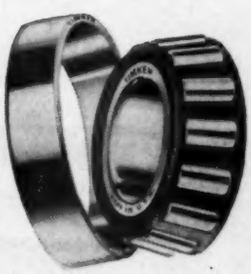
The special grade alloy steel which gives Timken bearings their strength and resistance to wear, is made in our own steel mills. It's the only way to positively assure uniformly high quality.

Timken is the only bearing manufacturer which makes its own steel, and leads in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

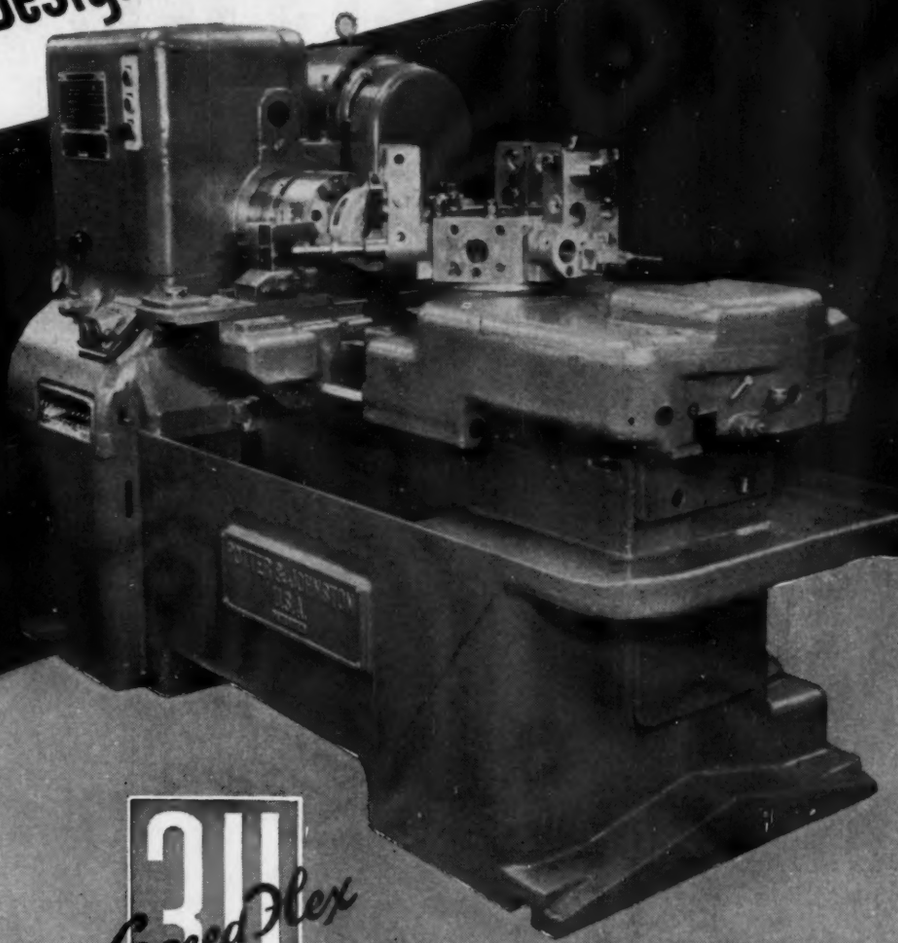
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST ←◎→ LOADS OR ANY COMBINATION

Modern in Design and Performance



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11 Models with 4, 5, 6 turret faces. Optional.

7 Models with 6 turret faces. Standard.

The NEW 30 *SpeedFlex* P&J AUTOMATIC TURRET LATHE

. . . an entirely new size for small work featuring:

. . . Modern Rigid Construction.

. . . Anti-Friction Bearings for mounting all high-speed shafts and spindle.

. . . Hardened and ground steel ways for turret slide are mounted on base.

. . . Hardened and ground steel inserts in turret slide.

. . . Gearing of chrome vanadium steel, heat treated and shaved.

. . . High Spindle Speeds: standard 73 to 1445 R.P.M. optional dual range 36 to 711 R.P.M. and 73 to 1445 R.P.M.

. . . Four automatic changes of speed with each set of hand pick off gears.

. . . Three automatic changes of feed with each set of hand pick off gears.

. . . Multiple disc clutches employed for speed and feed changes.

. . . Ample power and speed for use of tungsten carbide tools.

. . . Electro-Pneumatic control of speed and feed changes and rapid traverse.

. . . Split-second timing . . . 1/5 second for change from rapid traverse to feed and vice versa.

. . . Turret Slide can drop from rapid traverse into feed for 1/4" travel and return to rapid traverse in 2 seconds under set up conditions of top speed and 10 thousandths feed per R.P.M.

. . . Rapid Traverse movement of turret slide and cross slides for one *complete* cycle of machine in 24 seconds.

. . . Rigid turret slide; turret automatically clamped in position after indexing; indexing by Geneva motion.

. . . Turret alignment with spindle accomplished by a locking and binding wedge.

. . . Safety cut out switch in case of air failure.

. . . Automatic stop at completion of work cycle.

. . . Full electrical controls.

Write for detailed specifications

POTTER & JOHNSTON MACHINE CO.,

Pioneer Manufacturer of Automatic Turret Lathes

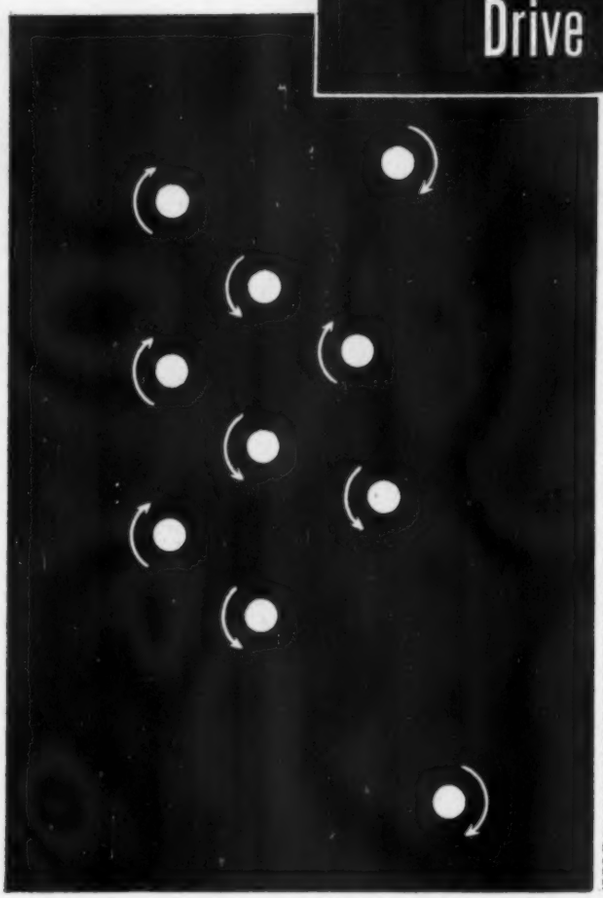
PAWTUCKET, RHODE ISLAND

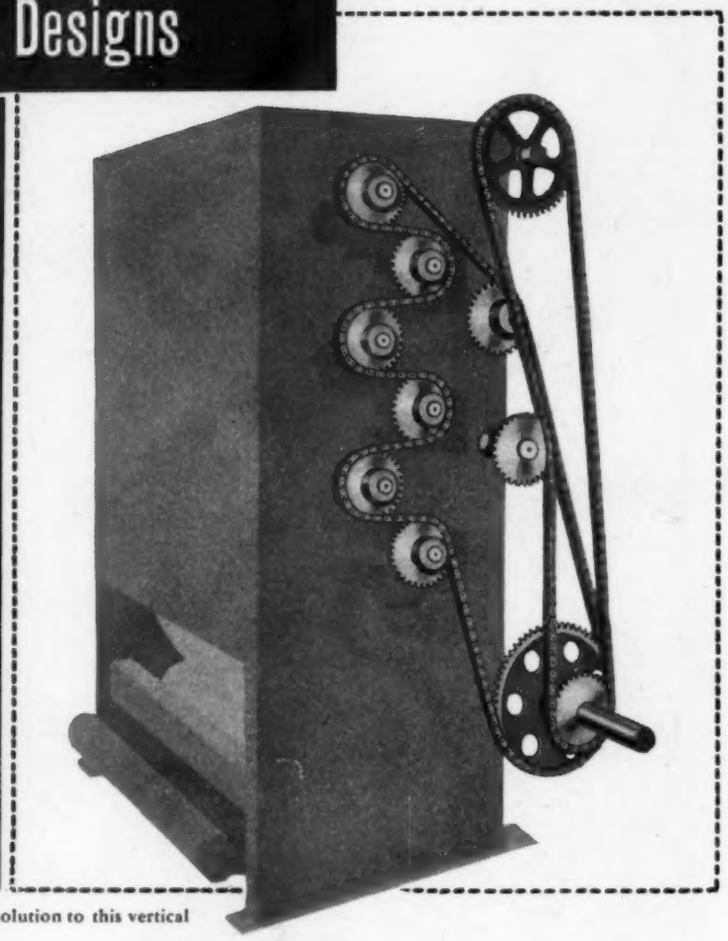
Where Shafts must turn . . .

Whitney

ROLLER CHAINS AND SPROCKETS

Solve Your Complicated Drive Designs





Whitney Roller Chain provided the solution to this vertical brush drive problem.

Whether it is a vertical brush drive or a horizontal boring mill, the *flexibility* of Whitney Roller Chain Drives makes them the first choice of designers for use in all types of equipment, standard or special.

Whitney Roller Chains . . . *the all steel drives*. . . . deliver full power because there is no slippage, and friction loss is negligible. The cushioning effect of the roller chain construction plus the ruggedness and toughness of Whitney Chains withstands shock loads. Operating slack on short or long centers, Whitney Chains do not impose unnecessary tension loads on shafts or bearings.

Teamed up with these efficient chains are accurately made Whitney Cut Tooth Sprockets . . . correctly designed to insure smooth, quiet performance and maximum operating efficiency.

Investigate versatile Whitney Roller Chain Drives for your designs. Our engineers will help you with your drive problems. Write:

The WHITNEY CHAIN
AND MANUFACTURING COMPANY
HARTFORD 2, CONNECTICUT

HARDINGE
ELMIRA, N.Y.

High Speed Precision *Universal* Milling Machine

for Profitable Tool Room and Laboratory Milling

Analysis of investment and time costs will prove that large milling machines are too expensive and slow for most tool room and laboratory milling operations.

Hardinge Model UM High Speed Precision Universal Milling Machines are designed to meet the definite need of tool room and laboratory for precision, ruggedness, extreme accuracy and ease of operation.

Specifications

1" through collet capacity for both cutter and dividing head spindles; 11½" longitudinal, 13¼" vertical, 5½" transverse travel; power feed for table ⅛" to 13" per minute; 7" swing universal spiral dividing head; spiral leads from .600" to 42.656"; eight speeds from 110 to 1850 r.p.m.

Also available in TM Model with non-swiveling table and Universal Plain Dividing Head.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

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Wyckoff Pre-Treated Cold Finished Steel Bars are custom quenched and tempered to your specified physical properties, —then cold finished for desired surface finish and size.

This *Pre-Treating* saves you money . . . eliminates handling and heat treating operations in your shop . . . and yields greater uniformity of physical properties than either bar treating in small batches or parts treating.

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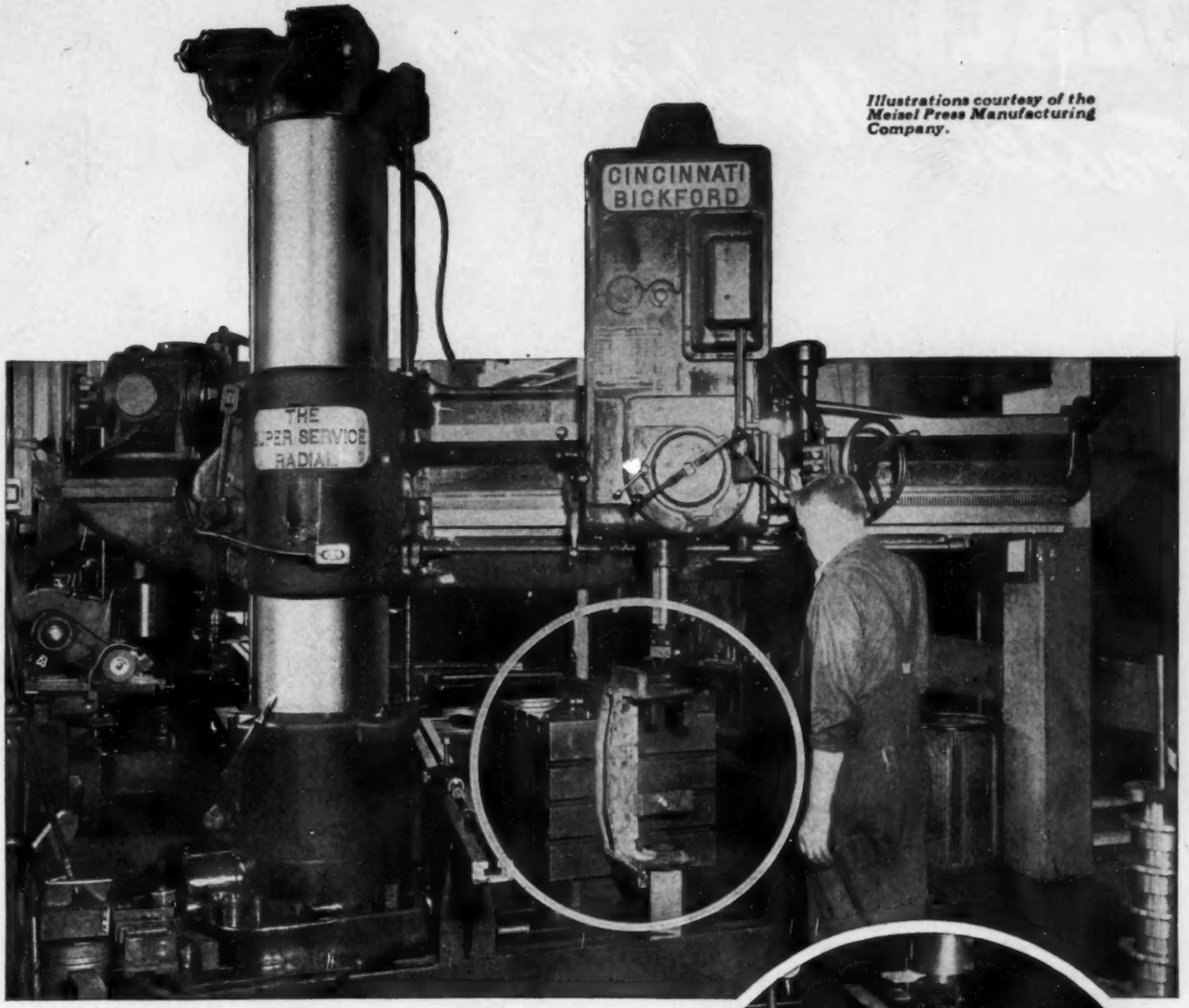
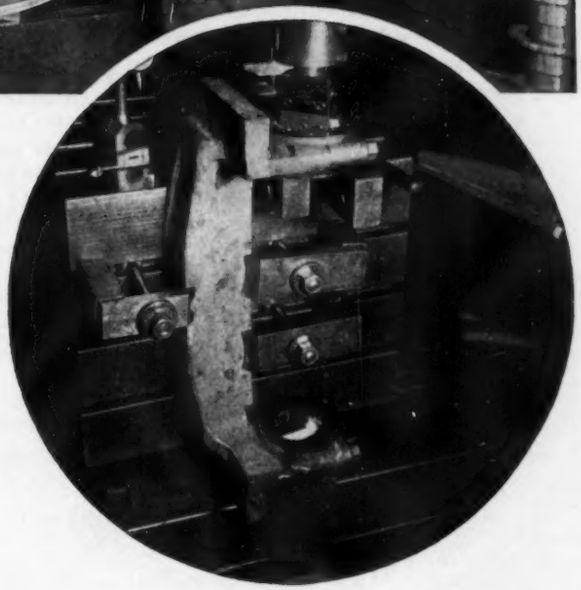


Illustrations courtesy of the Meisel Press Manufacturing Company.

LIMITS WERE CLOSE!



Boring and reaming the main bearings of a cutting cylinder to .0005 limits with a Cincinnati Bickford Super Service Radial Drill has effected a 20% saving over previous machines at the Meisel Press Manufacturing Company, Boston, Massachusetts.

The accuracy of Cincinnati Bickford Super Service Radial Drills, and their ease of handling, made this worthwhile saving possible in small lot production.

Write for detailed Bulletin R-24A.

See our condensed Catalog in Sweet's File.

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

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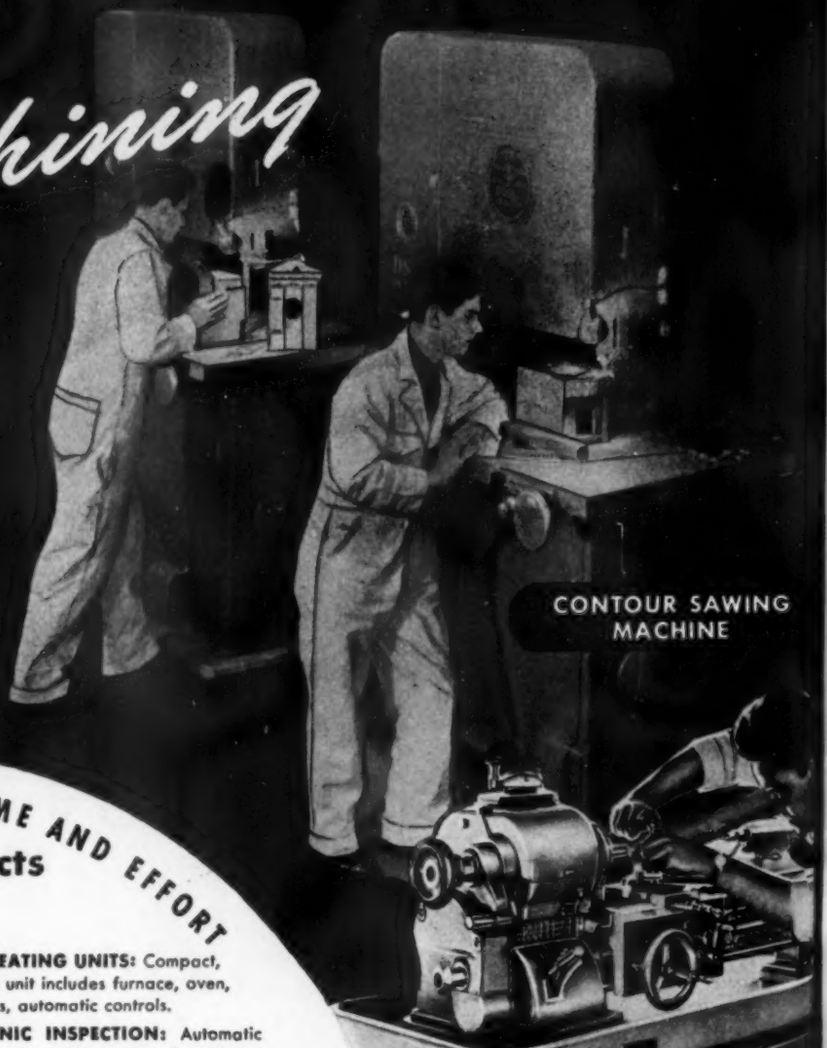
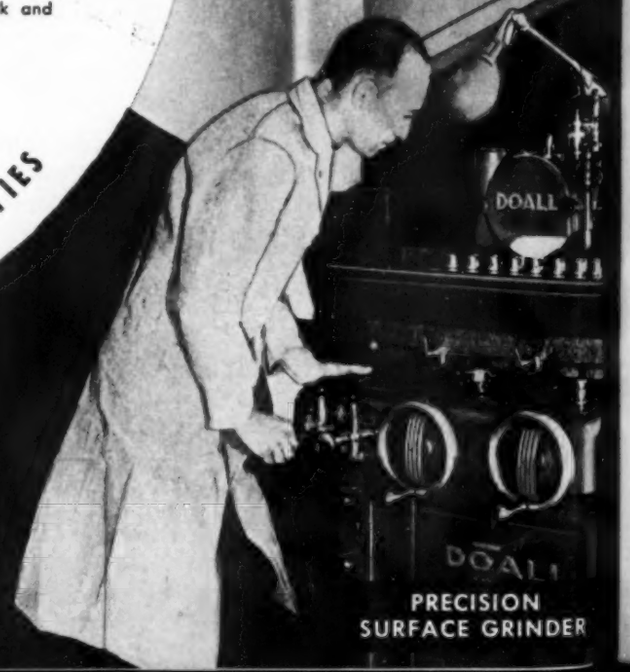
Faster Machining



CONTOUR SAWING MACHINE

TOOLMAKERS' LATHE



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ONE SOURCE SAVES YOU TIME AND EFFORT

DoALL Products *Include:*

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- **BAND SAW BLADES:** Razor-sharp, superhard teeth. No resharpening needed.
- **BAND FILING MACHINES:** 9 times faster than hand filing, 4 times faster than jig filing.
- **JIG FILING MACHINES:** For more intricate work. Perfectly straight filing.
- **FILES:** All kinds — file bands, jig files, rotary files, hand files.
- **SURFACE GRINDERS:** 6 models. Hydraulic, precision type for toolrooms and production. Also grinding wheels, magnetic chucks, cutting oils, coolant systems, dust collectors, etc.
- **SPOT WELDERS:** New "True-Pressure" type having straight up-and-down movement. No tip skidding.
- **HEAT-TREATING UNITS:** Compact, combination unit includes furnace, oven, quench tanks, automatic controls.
- **ELECTRONIC INSPECTION:** Automatic inspection, sorting and counting of small parts, twice as fast as manual methods.
- **BENCH PROFILERS:** For great variety of small work—profiling, milling, slotting, routing, etc.
- **PRECISION LATHES AND HAND SCREW MACHINES:** Various types for toolroom and production lines.
- **RADIUS SHAPER-MILLER:** 1 setup for many operations—has a thousand production uses.
- **VARIABLE SPEED DRIVES:** Smooth speed-changing drives. Infinitely variable.
- **GAGE BLOCKS AND INSPECTION INSTRUMENTS:** The finest for precision work.
- **TOOL-AND-DIE STEEL:** Non-warping, precision-ground up to 1 inch thick and 6 inches wide.

The DoALL *Company*
Reg. U. S. Pat. Off.

REPRESENTATIVES IN 56 COUNTRIES

Cable Address: DoALL, Des Plaines

Des Plaines, Illinois

DoALL SALES AND SERVICE STORES IN KEY CITIES

Send for free pictorial booklet "DoALL EQUALS TEN PLUS" which compares fast, efficient Contour Machining with other metal-cutting processes. Shows how this miracle method of low-cost production makes great economies.

Spot American Machinist's NEWS OF METALWORKING

Certain oil companies are reported working feverishly to build "cat" (catalytic) oil refining plants to produce 95-octane fuel for 1951 cars. Automobile engines with overhead valves now are being developed or tested using this high anti-knock gasoline. Ten-to-one compression ratios will be utilized.

A hot-air engine suitable for commercial use has been developed by Philips Incandescent Lamp Works in The Netherlands. It can be built in any power volume and is adaptable to automobiles, locomotives, and generating electricity for industry and for homes. Its fuel is gasoline or oil or methyl-alcohol or coal gas. Noise of a 15-hp. engine is equal to that of a small sewing machine. It runs at 3000 rpm. or higher, has no spark plugs.

A "defense-against-unemployment" program has been started by the CIO Electrical Workers, which points to at least 50,000 unemployed in the electrical manufacturing industry. Local unions are urged to make these demands in future negotiations: 1) no overtime when the full force is not working, 2) re-employment of laid-off workers before hiring new ones, 3) severance pay in layoffs.

Barter is being employed effectively by firms in the Soviet sector of Austria. Wertheim AG at Vienna has provided hoists for Heid AG, Austria's largest machine tool builder, in exchange for lathes. Heid also has exchanged lathes for anti-friction bearings from Sweden and gear-generating equipment from Switzerland.

> **Productivity is up sharply compared with a year ago in the automotive industry. In some departments of one important company, it is higher than prewar. Productivity would be still greater if it were not for materials shortages. Detroit believes that output per worker soon will be back to the prewar level or better.**

Curtiss-Wright has developed an automatic electric starter clutch for automobile engines, has installed it on special race cars. Clutches will be built by LGS Co., now a C-W subsidiary.

Office equipment firm with several hundred models and 2000 optional features has reduced line to 17 models with four options. Results: increased production, greater output per manhour, decreased cost of training, reduced set-up and down-time.

Soviet machine tool builders started production of 53 new types of machines during 1946, including horizontal boring machines, internal grinders, surface grinders and vertical multiple-spindle, semi-automatic lathes. Machine tool output in Russia will not reach the prewar level until 1948, but by 1950 annual capacity will be expanded to 74,000 machines.

Number of women in proportion to total factory working forces is steadily declining, having dropped from 38% in the last month of the war to 30% in January, 1947. As of the January count, there were 14,840,000 women workers employed.

Further note on productivity: though output per man in many metalworking shops has been restored to the 1939 level, expenditures for new equipment indicate a sizable gain in productivity to compensate for the expense. Present-day worker often expends more energy in his job than his experienced predecessor, but does not know as much about keeping his machine in good condition and is more awkward in his work habits.

There is little if any opposition by workers to introduction of new machine tools which mechanize operations and speed production, according to a group of large metalworking manufacturers. Opposition falls close to zero when a plant is being completely retooled.

Mercedes V-12 car raced at Indianapolis on Memorial Day by Don Lee, Jr., has a body and many engine parts made from sheet, cast or extruded magnesium. Car was lightest (1500 lb.) and highest-powered (600 hp.) on the Speedway, has independent coil-spring suspension on all wheels.

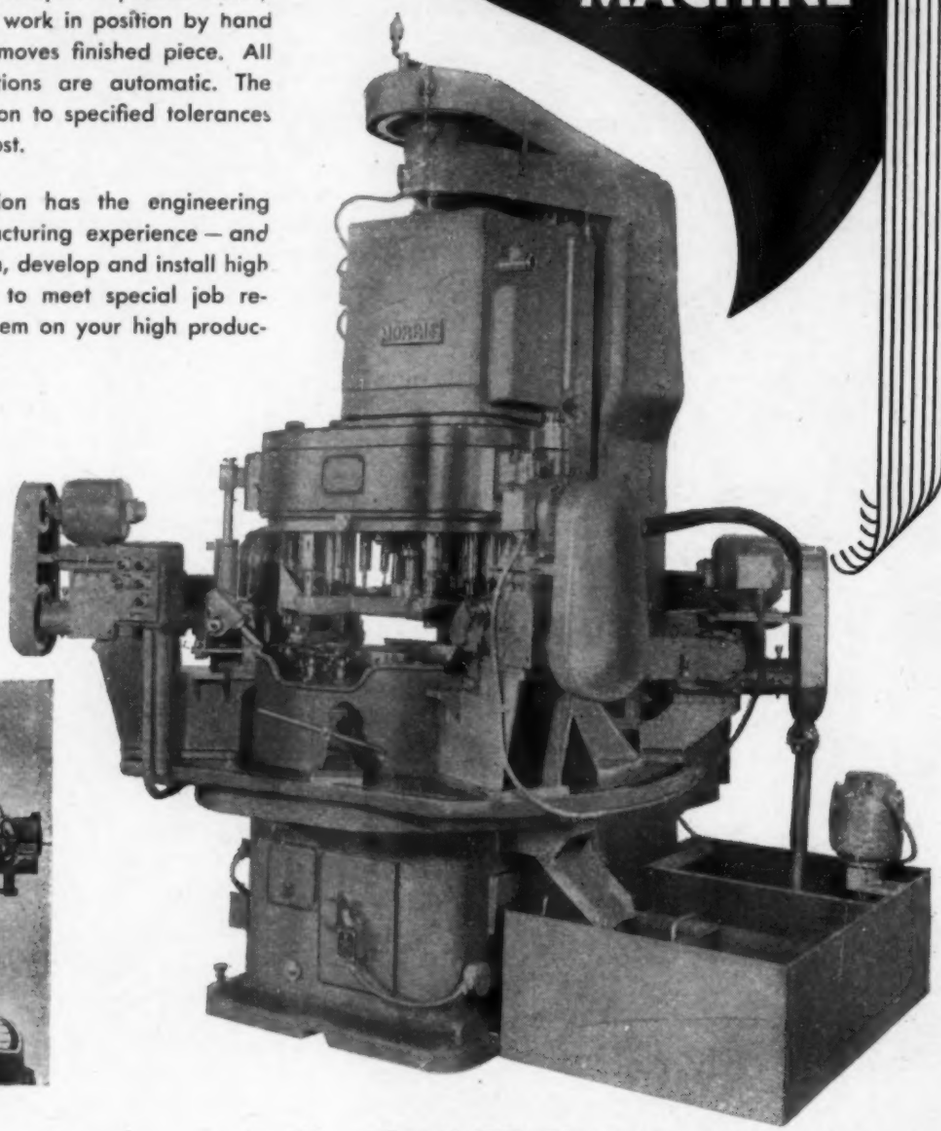
MORRIS
MOR-SPEED
Six-Station
Vertical Hydraulic MACHINE

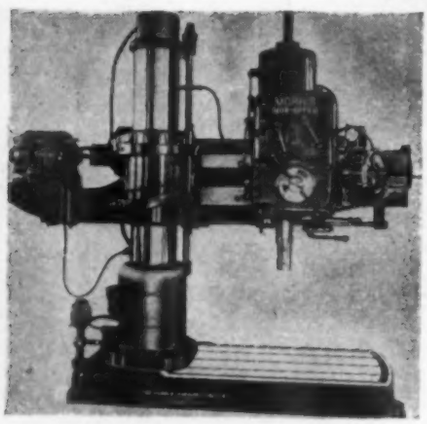
● Illustrated is a Morris high production machine of Vertical design with hydraulic automatically operated indexing fixtures.

The operations consist of drilling, reaming, counterboring, countersinking and chamfering holes in various positions in Refrigerator Compression Cylinder parts. There are thirty-one vertical spindles driven by a hydraulic unit and eight horizontal spindles rack fed from hydraulic unit.

Operation is extremely simple. Operator merely loads and clamps the work in position by hand and unclamps and removes finished piece. All other operating functions are automatic. The result is high production to specified tolerances at exceptionally low cost.

The Morris organization has the engineering "know how" — manufacturing experience — and shop facilities to design, develop and install high production equipment to meet special job requirements. Consult them on your high production jobs.





MORRIS MOR-SPEED RADIAL

Builders of MOR-SPEED Radials

The MORRIS *Machine Tool Co.*

CINCINNATI 3, OHIO

American Machinist

MAGAZINE OF METALWORKING PRODUCTION ★ ESTABLISHED 1877

An Unsound Wage Policy

The trend toward a uniform national increase in hourly rates in industry, if allowed to continue, will be harmful to the country's economy. In fact, it may spell disaster.

President Truman has the dubious distinction of having fathered the trend, as a result of his advocacy of an 18½-cent-an-hour increase in rates early last year.

Unions were quick to push it. They wanted rate advances agreed upon by a few large corporations as a pattern to which all of industry would be expected to conform.

After the "first round" was granted, unions began agitating for a "second round."

General Motors provided the test case this year. Its new contract specified an hourly increase, plus other benefits, which added up to 15 cents an hour. Now union pressure is being put on all companies, large and small, to hike wage rates an equivalent amount.

What good reason is there for companies in all industries—textiles, metalworking, food—to agree to a uniform boost?

Seldom is the economic situation in one industry exactly comparable with that in another. Moreover, seldom is the situation in one company exactly comparable with that in another in the same industry.

Company A may be in a much more favorable position to pay a major increase than company B. But experience may show that company B has a more stable business than company A and hence offers greater job security. Is there any logic then in forcing both firms to advance hourly rates the same amount?

United States government statistics reveal that the cost of living is not the same in all communities. One can live for less in Rutland, Vt., than in Detroit. Fluctuations in living costs are not uniform in Rutland and Detroit.

Ups and downs in living costs occur in a thousand communities across the country, each of which is affected by local or regional conditions.

What justification is there, under the circumstances, for raising hourly rates a like amount in all cities from the Atlantic to the Pacific?

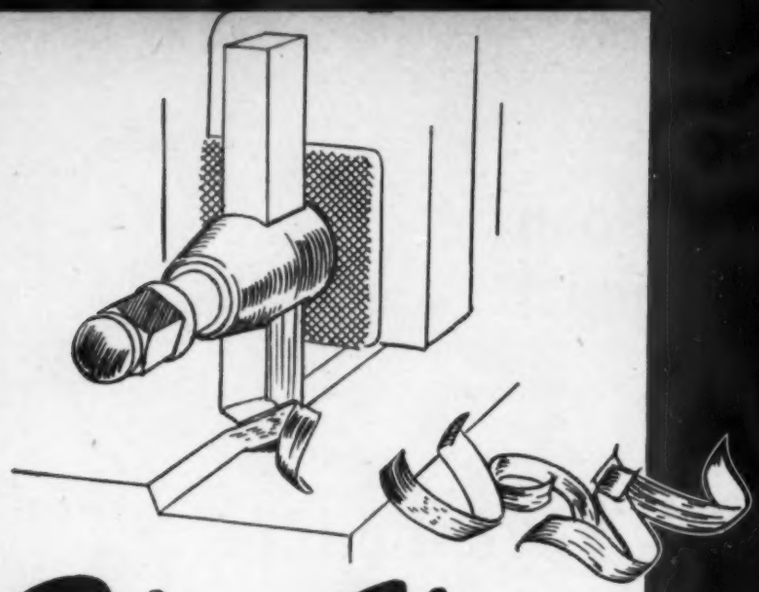
The answer is "none." When the federal government applied the heat in early 1946 for a uniform increase as the way out of a wage dispute, unions took advantage of the situation to try to establish an annual wage pattern to apply "across the board" everywhere, no matter what the industry or company or locality.

If this attempt is permitted to go unchallenged, and a uniform national wage pattern takes hold in all industries, disruptions to the national economy are inevitable.

These disruptions will lead to distress, unemployment and inability of many companies to survive on a competitive basis.

Burnham Finney

EDITOR



Blue Chips

Cincinnati Shapers cut blue chips that are profitable chips. Blue chips come from tough die steels that present unusually tough machining problems.

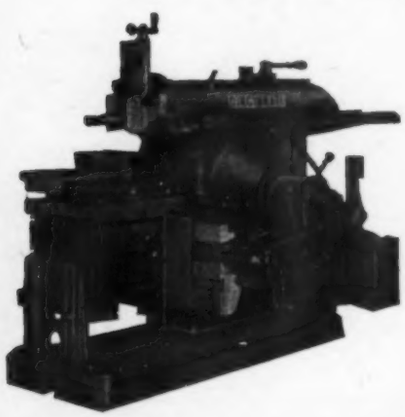
The machine must be accurate in performance, must deliver unusual power at the cutting tool, and must have great stamina. On these things hinges the profitable handling of these tough steels.

Cincinnati Shapers, with their outstanding performance, are found in large numbers in tool and die plants everywhere.

Our representative in your neighborhood will gladly consult with you on increasing accuracy and profit in your shop.

Our Engineering Department is at your service. Ask their advice on your shaping problems.

Write for Catalog N-3



• THREE TIMES AS TOUGH . . .
By test, die steels are often three times as tough as mild steel—and machining demands are correspondingly more severe.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

Replacement Essentials:

1 START EARLY
2 CHECK REGULARLY
3 HAVE A PROGRAM

Though average age of equipment is only 3½ yr., Micro Switch plans to reinvest in machinery replacement the approximate amount of depreciation charges

BY W. W. GILMORE
PRESIDENT, MICRO SWITCH

FROM one standpoint, Micro Switch has at this time a less urgent need for a machine-replacement policy than have many manufacturing firms. We were a tiny business until the war. Then the need for our product in many combat items, particularly airplanes, forced an expansion program.

We still are small, in comparison with the big names of industry. But our growth under the forced sunshine of war production brought about a condition in which most of our machinery is relatively new. The average age of our machine tools, production machinery other than tools, and laboratory equipment is in the neighborhood of 3½ years. At most, 15% of this is more than 5 years old. Obsolescence and wear have therefore taken relatively slight toll of our plant equipment.

Oddly enough, what brought us face-to-face with the need to develop a replacement policy was not factory equipment, but typewriters. Some of our pre-war typewriters were still on the job a few months ago—probably including the first machines with which our company started its office work in 1937. These had been passed along to those points in the company where quality of typing and skill of the typist were not required—used for such operations as writing plant job tickets. Our newest and best machines were in the front offices.

One day, after the office manager had forcibly delivered to the executive committee his conviction that we had to get some new machines or else, it dawned upon us that unless we should start buying new ones and trading in the old ones, we would eventually face the necessity of purchasing a large number of typewriters at one stroke. Also, that the quality of typing would be deteriorating steadily because no new machines would be available for the work that really must look its best as an outside representative of the company.

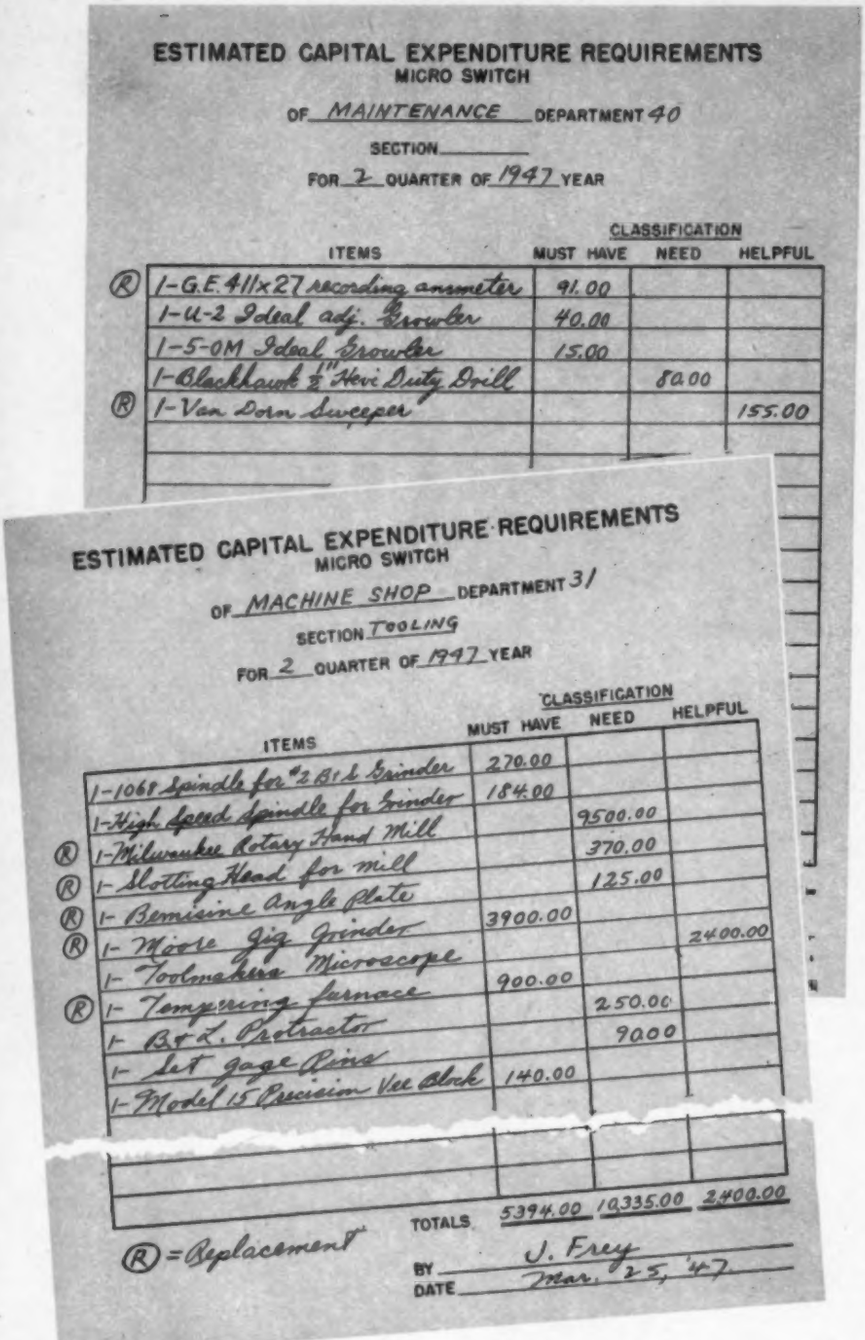
The upshot was that we dug into the facts of typewriter life and service, then formulated a policy. We started in to replace these office machines at the rate of 2% a month, which means a complete turnover in four years. Measured against the needs of our business, this seems to be just about right.

We began also to think about machine tools and other plant equipment. Because plant machinery had not presented any major problems of replacement, we had not attempted to formulate a policy to cover it. But it was evident that unless we should get a policy working on plant equipment, we must eventually face a predicament like that with the typewriters.

Our policy on machinery replacement has not yet been developed to the detailed stage in which we can apply it automatically. But we know in a general way what we are going to do, and we have in effect some adequate procedures in the interim.

The interim procedure is, in fact, something which will surely be continued even after we complete the finishing touches on our basic policy. As it works out, it prevents any department from drifting into a state of complacency when it should be aggressively trying to improve the caliber of its machines. And it keeps the general management of the business rather more completely informed on the needs and possibilities of better machinery than was true before.

First step in our procedure is to fill in a quarterly "Estimated Capital Expenditure Requirements." Two to three weeks before the beginning of a new calendar quarter, the front office sends to each department head a sufficient number of these blanks to cover the sections for which he is responsible. We have found that promptest and best results are achieved always by sending along a letter of explanation and instruction, bringing up to date the latest information or shifts of policy that affect its use. Thus the recipient's memory is jogged, his interest is



ESTIMATED CAPITAL EXPENDITURE REQUIREMENTS
MICRO SWITCH

OF MAINTENANCE DEPARTMENT 40

SECTION

FOR 2 QUARTER OF 1947 YEAR

	ITEMS	CLASSIFICATION MUST HAVE	NEED	HELPFUL
®	1-G.E. 411x27 recording anemeter	91.00		
	1-U-2 Ideal adj. Growler	40.00		
	1-5-0M Ideal Growler	15.00		
	1-Blackhawk ½" Heri Duty Drill		80.00	
®	1-Van Dorn Sweeper			155.00

ESTIMATED CAPITAL EXPENDITURE REQUIREMENTS
MICRO SWITCH

OF MACHINE SHOP DEPARTMENT 31

SECTION TOOLING

FOR 2 QUARTER OF 1947 YEAR

	ITEMS	CLASSIFICATION MUST HAVE	NEED	HELPFUL
	1-1068 Spindle for #2 B & L Grinder	270.00		
	1-High Speed Spindle for Grinder	184.00		
®	1-Milwaukee Rotary Hand Mill		9500.00	
®	1-Slotting Head for mill		370.00	
®	1-Bemisine Angle Plate		125.00	
®	1-Moore Jig Grinder	3900.00		
	1-Toolmakers Microscope			2400.00
®	1-Tempering furnace	900.00		
	1-B & L. Protractor		250.00	
	1-Set Gage Pins		9000	
	1-Model 15 Precision Vee Block	140.00		
	TOTALS	5394.00	10335.00	2400.00

® = Replacement

BY J. Frey

DATE Mar. 25, '47

Here are two examples of the quarterly "Estimated Expenditure Requirements" form, one for Maintenance, the other for the Tooling Section, Machine Shop. Replacement items are shown by a circled R

aroused, and requested reports come flocking back in good order and good season.

Examination of the typical form illustrated is sufficient to get the general idea. The differences between the three classifications on the report are well covered in the instruction letter that went out for the second quarter of 1947:

"One of the points deserving careful consideration is the actual status and meaning of the categories of *Must*, *Needed*, and *Helpful* used in the preparation of these estimates. First, it is highly desirable that every capital expenditure made during the quarter should have appeared in one of these categories. Its appearance on these estimates does not guarantee that it will be approved for purchase.

"The items in these categories are simply the statements of the opinions of those making out the prime information from which the estimates are assembled. They are also subject to the opinions of others. . . . Each item that appears in the *Must* category should be followed by an Authorization for Expenditure sometime during the quarter.

"The *Needed* category has a lower urgency status than the *Must* and it is likely that many items shown in this group will never be purchased, although many of them will advance to the *Must* group as requirements for them become more urgent.

"The *Helpful* column was devised to give those making the estimates an opportunity to mention any equipment thought to be desirable for the better operations of their responsibilities, without their being faced with any sort of justification for its listing. It is recognized that items appearing in this group will often be minor in operating benefits, or may be looking so far into future requirements that their utility may not be apparent to anyone outside the department involved. It is a wise estimator who will use this column as a suggestion or a warning of things to come. He will find that familiarity with an item appearing frequently in this column may greatly help its ultimate purchase.

"It is expected that special explanation will be required for the purchase of any considerable item that has not appeared on the estimates for that quarter. Equally, reasons should be given for not starting an Authorization for Expenditure for any item appearing as a *Must*."

Handling Requirements

Items appearing on the quarterly estimates get first-hand investigation by the executive responsible for plant methods. He checks them with the department head and foreman, discusses just how the need arises, how its fulfillment will prove profitable, and whether there is perhaps a better way to perform the operation or manufacture the piece than that presumed by the estimate of equipment to be purchased. These personal reviews of the situation often lead to a change in the category of the item. Some items turn out to be less urgent than the originator had thought. Others seem, on close examination, to offer greater possibilities of product improvement or increased output than were first thought, and these move up the scale.

The effectiveness of this method is difficult to get across to someone who has not watched it in operation. The man who originates the estimate knows that ample suggestions

AUTHORIZED CAPITAL EXPENDITURE - 2ND QUARTER 1947

PRODUCTION		MUST HAVE
Department 31 - Machine Shop - Tooling		
(1) 1068 Spindle for #2 B & S grinder		$270.00
(1) High-speed spindle for #2 B & S grinder		184.00
(1) Moore jig grinder		3,900.00
Ⓡ (1) Tempering furnace		900.00
Ⓡ (1) Model 15 Precision Vee Block		140.00
	Total	$5,394.00
Department 40 - Maintenance		
(1) G.E. 411 x 27 recording ammeter		$91.00
Ⓡ (1) U-2 Ideal adjustment growler		40.00
(1) 5-OM Ideal growler		15.00
	Total	$146.00

Ⓡ = Replacement

Authorized expenditures for the same two departments—all *Must Have* items are to be purchased

are an indication that he is alert, but that suggestions in the upper two categories which cannot be well substantiated as desirable reflect no great credit upon him. Consequently he tries his best to find ways to improve his departmental equipment, and to exclude from the *Must* or *Needed* columns anything that he cannot prove belongs there.

The estimate forms are expected to include any capital expenditures, whether for replacement of present machinery or for additional capacity. Usually the originator indicates which purpose is intended. But in an organization no larger than ours this is not requisite, since everybody who considers the purchases knows which is which.

Our general intention is to reinvest in replacement equipment the approximate amount of our depreciation charges. Obviously, unless a manufacturer does approximately this well in replacing machinery, he is in effect shipping part of his assets out the door with each delivery, or including the equivalent in the shareholders' dividend checks.

The direction toward which we are working in formulating a definitive policy of machinery replacement is to replace a regular percentage of our equipment each quarter. The replacement — not plant-extension — items which run the gauntlet of executive scrutiny and still manage to retain their place in the *Must* category would, under such a program, have first priority on replacement purchase funds for the quarter. Then presumably would come those replacement items on the *Need* list which can be supported as promising the best returns on the investment. It seems a safe guess that the two top-priority columns will always add up to more dollars than the depreciation reserve account, unless plant men change their expectable tendency to have greater ambitions for their departments than the treasurer has funds available to gratify.

Results

Thus far, the *Must-Need-Helpful* procedure has kept us replacing machinery and other equipment at a rate not far short of the ideal. We have every confidence that, as the average age of plant equipment increases, the high-priority items would absorb the available funds.

But we believe that it will be better to work out our policy in greater detail and make it effective in such form, rather than rely on our interim method. We are aiming at a regularized rate of monthly outlay for replacements, directed where it will do the most good.

Our policy as respects replacement of machine tools and of production machinery of other sorts performing the same general type of plant function certainly will be based on spending accrued amortization plus what the old machine will bring. Machines will probably be replaced in the order in which they show wear, require maintenance expense beyond the point of true economy, show obsolescence because of improvements in new models available, show obsolescence because we have the opportunity to improve our manufacturing processes, or just because they get old.

Whatever basis is eventually chosen, it is a fair guess that the first warning of the need for replacement will then as now be gained from factory-rejection reports. The backbone of our business is extreme accuracy; it is impossible to make tiny switches that will operate properly unless they are made to close tolerances. Our quality control is therefore extremely detailed and exacting. As soon as rejections begin to rise, we get after the point of origin to find which is responsible, the operator or the machine.

If this turns out to be the machine, then it gets a prompt survey to determine whether it should be repaired or replaced. Types of machine tools which manufacturers are content to allow to remain practically the same year after year are usually more profitable to repair than replace. But if the manufacturer of the machine tool continues to make it better with each succeeding model, there is a good chance that the decision will be to buy the newer, better machine and sell the old.

Causes of Replacement

In our machine shop, which is really a toolroom, obsolescence and lack of accuracy are the most frequent causes of replacements. The workers here have the highest skill requirement in our plant and their wage rates are correspondingly high. It is consequently most likely to be profitable if we keep them supplied with the very latest and best machinery.

Our departments, which include drill and kick presses and screw machines, are most likely to justify a replacement purchase for reasons of accuracy and capacity. Screw machines come in for special scrutiny when they reach the state of wear at which the operators cannot hold them to required accuracy. It happens that screw operations are more often the secret of the accuracy of our switches than are any other processes. So we keep these machines up to the highest level of maintenance, and replace them when this seems economical.

In our hydraulic press and plastics department, our experience has not been long enough to give us an absolute measure of what to watch for. The equipment is still too new. But we are guessing that the chief reason for replacement here will prove to be that new molding compounds and new models of presses will permit faster cycle time.

Snakes in the Glass

Specialized honing technique is found adaptable to maintenance of small bores as well. Recent experiments point to extensive service setup for Metalworking

By Ananias MacHinery

LATE in the war, we had a rush order for diesel injector nozzles requiring jet holes 0.004 in. in diameter. We were able to drill the holes without too much difficulty, but could not obtain the proper finish, so spray characteristics were poor.

The problem was serious enough that I "took it home with me"—and found myself mentioning it to a wizened old man who sat next to me at an "E" award meeting. Although he was obviously not a shop man, he was so interested I told him the whole story in the hope that telling it would give me an idea. I was so wound up in it that he startled me when he said suddenly, "Why not use snakes for laps?"

I started to laugh, but then I realized he was dead serious. As I began to suspect he was a little "queer," he went on: "When I was younger, I was quite a herpetologist —which you'd call an expert on snakes. As a boy you probably heard that old wives' tale about how a horse hair left in salt water overnight will turn into a snake. If you tried it, you found out it isn't true, but there *is* a hair snake that lives in water."

Serpent Honing

Pat Ireland (the old man) readily agreed to hunt up some hair snakes and bring them in. We found that we could handle the lapping easily by putting abrasive flour in water (a good suspension was obtained by homogenizing). Drilled nozzles were nested in a tight tube of the emulsion through which the snakes wriggled. Their minute scales entrained enough abrasive to hone the holes properly.

We have since tried the same technique on a number of other jobs, including honing larger bores and cleaning caked or gummy deposits from oil lines, scale from induction-heating coils and the like. These latter jobs, because of the length of the bores, were found to cause irritation of the snake's skin from the abrasive used. This was readily overcome by selecting tougher-skinned species and by metallizing the snakes with harder steels, Stellite or carbides, thus converting the process to honing.

We also found that various species propel themselves in various ways, some using merely a flexing motion, some wriggling, and some actually coiling and uncoiling like a helical spring. These latter, *dormum augeratus*, are excellent for removing deposits in larger bores, but are lethargic, so it was necessary to crossbreed them with a more agile species, *hasticus acceleraticum*. This introduced a new problem, however, because the latter breed was a land snake and the offspring could not live in either water or air—so must of necessity be kept in a mist. Hardier individuals could, however, actually be caused to work faster by placing them in a dry tube, with a mist blown accross the far end.

Industrious individuals created an unexpected problem in that they would frequently scrape through, or at least thin, tube wall particularly of softer materials such as copper. Changing the metalsprayed alloy did not overcome the difficulty because a material too soft to cut the tube was also usually too soft to cut the scale or other deposit as well.

Mr. Ireland suggested a simple remedy for the problem—attaching a charged follower wire to the snake's tail by a Kellems come-along. Because of the size of the wires which made it up, some difficulty was encountered in producing the come-alongs, but it was found that ladies with delicate upbringing could do so at night. This offended an ancient Connecticut statue, restricting hours of labor for women.

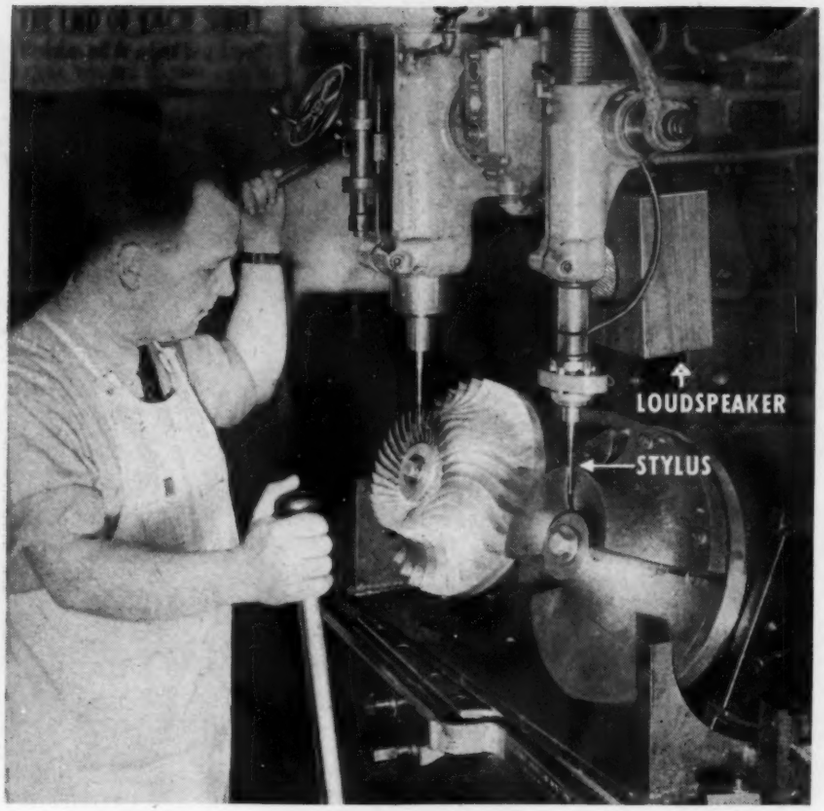
With this device, however, the snakes bored and scraped to bare metal; then slight shocks encouraged them to move on. Further, the cleaning action is accelerated by allowing the snake to coil about a thin metal rod, which is heated by the inductive effect of the current in the snake's body, thus heating the surrounding mist to steam. This is also of advantage in another recent series of experiments, that of grinding, or more properly honing, modified-V internal threads.

Grinding Internal Threads

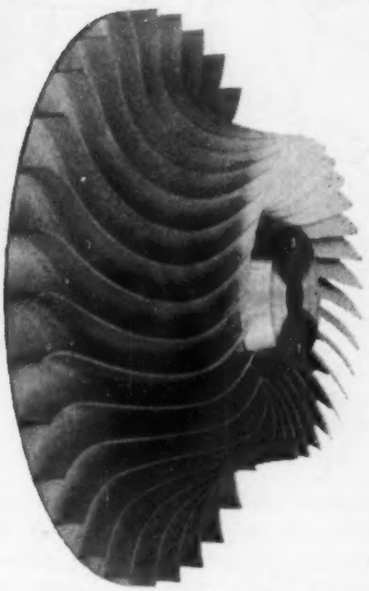
The snake, to get away as far as possible from the heat generated in the rod, will conform to the thread helix and advance along it. It is, of course, necessary to select a right-hand snake for right-hand threads and vice versa, although the left-hand ones exhibit the usual tendency to be ambidextrous. Further, it is essential to avoid selection of a snake with too large or too small a natural lead, because they are capable of honing across ridges and stripping the thread.

We have recently been plagued by absenteeism and high turnover, particularly in complicated systems. All lures fail upon occasion to entice a particular individual or pair from complex systems involving enclosed splash pans and reservoirs, and it is necessary to assign a crew of men to watch gage glasses and trap the recalcitrants by valving as they wriggle through.

If present plans mature, however, we expect soon to have a sufficient working force of reptiles to license local service agencies in all countries of the world except Ireland.



Vertical movement of the cutter spindle and stylus is controlled by the left hand, the right controlling horizontal movement of the table. A direct audio signal through the loudspeaker at right translates stylus pressure (and deflection) to the operator and enables him to maintain a predetermined pressure on the cutter to protect the thin blades of this impeller



TONE STYLUS PROVIDES PRECISE DUPLICATING

Applied tension on the stylus, when converted to sound by a signal device, allows operators to mill thin contour sections rapidly and to close limits

BY H. L. SEEKINS
Aircraft Gas Turbine Division
Lynn River Works
GENERAL ELECTRIC COMPANY

SOUND AND VIBRATION, which sometimes defeat precision manufacture, have been harnessed in the interest of precision at the General Electric plant in Lynn, Mass. An "audible pressure-signalling device, or tone stylus, has been developed for a manually operated, profile-duplicating milling machine which cuts centrifugal impellers for aircraft turbosuperchargers and provides an audio control means for fast duplication of contours.

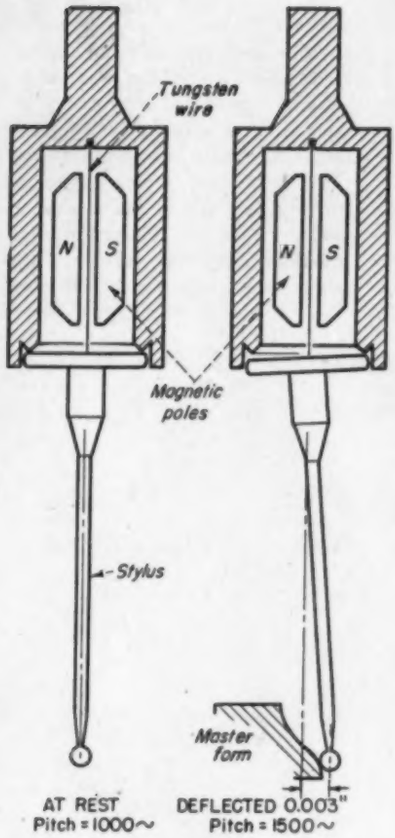
This device can be applied wherever it is necessary to translate minute displacements or low pressures into corresponding audio signals. It can be made sensitive to a displacement as low as one ten-millionth of an inch.

The thin (less than 1/16-in.) sections and deep contours of these impellers required a stylus about 4 in. long and ⅛ in. in dia. A small amount of pressure would bend the stylus about ⅛ in. and deflections of ⅜ in. were not uncommon. This made accurate control of cutting impossible.

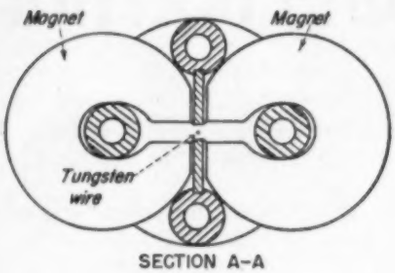
Major factors governing the accuracy of duplication of the master form are:

1. Rigidity of the stylus, cutter, master form and work section.
2. Limitations of the machine, (a) table friction, (b) table inertia (c) stylus friction and keenness of the cutter.
3. Operator's skill.
4. Machinability of the work.

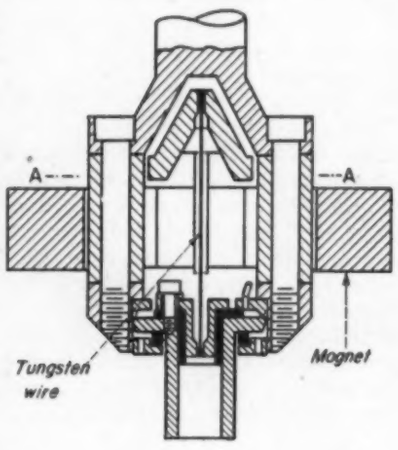
If rigidity of the stylus and skill of the operator alone were depended upon it would be almost impossible to produce a satisfactory piece of this type. These severe requirements indicated that the operator must have some means of knowing the amount of pressure he was applying on the stylus as he watched the cutter. Since his eyes were following the cutter, a visual indicator could not be used and an audible signal

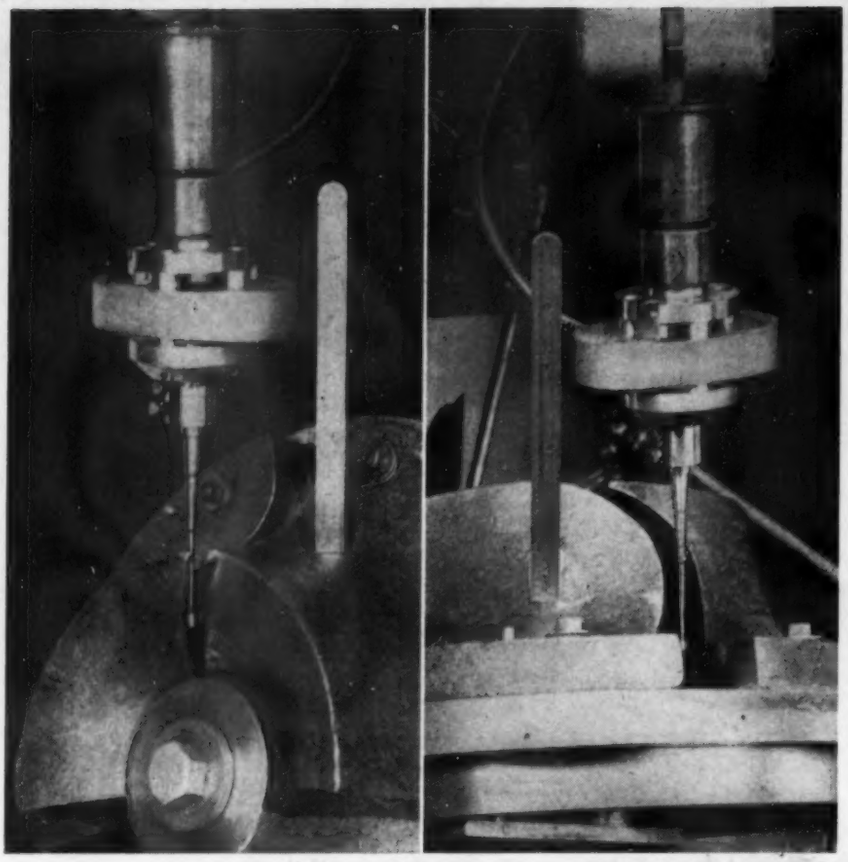


VIBRATION FREQUENCY of the stretched tungsten wire depends on applied tension and slight tension at low audio frequency changes the wire length to produce an audible change in pitch, as indicated in this preliminary basic design. Disposition of magnets and elements is below



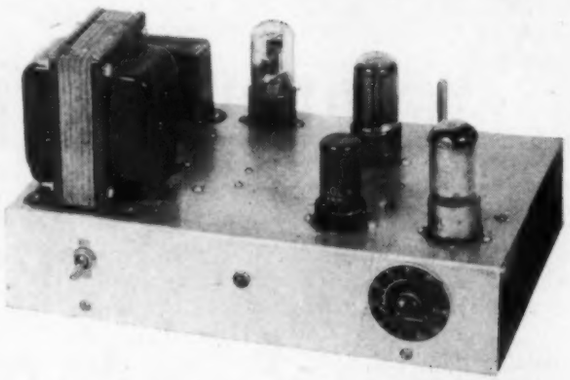
SECTION A-A

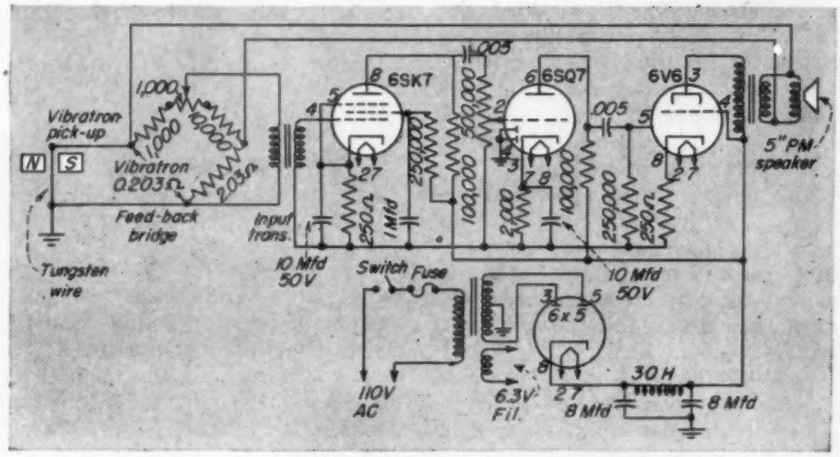




THE MASTER FORM, through an angular indexing head, is set for a cut parallel to the back of the impeller, at the left, while at the right it is set for a cut perpendicular to the back of the impeller

AMPLIFIER is hooked up with the tracer head to pass on an audible signal to the operator. The final circuit shown here has a feedback bridge to maintain the wire in vibration at all times. This prevents the operator from being distracted from his allowable pitch zone





indicator was the only one which could conceivably be used.

The audible control needed for this particular application had to provide a variable pitch tone continuously and the pitch of the tone had to be proportional to the applied pressure on the stylus. Because of the physical limitations imposed by a large-angle fixture, the work and the machine itself the pickup device had to be very compact. Original requirements allowed about 2½ in. in dia. by 2 in. long. Because of the length and slenderness of the stylus, it was necessary to develop a device operating within a displacement of about 0.0001 in. at a pressure of a few ounces. Several ideas were investigated in an effort to develop an audio-frequency oscillator controlled by a pressure-sensitive element which could be inserted on the duplicator between the stylus spindle and the stylus.

Control Elements

Control elements considered were a carbon microphone button, a crystalphono pickup, the electro-limit gage principle, a magneto-strictive element, an air jet and the currently used tone stylus and templet follower tracer, which alone provided a direct audio signal.

Operating principle of the device is that the natural vibrating frequency of a wire stretched between two points depends upon the applied tension, that is the higher the tension the higher the natural frequency of vibration. Calculations showed that with a 2-in. tungsten wire with very little tension at low audio frequency, less than one ten-millionth in. change in length would produce an octave change in pitch. An accompanying table indicates pitch change in half octaves.

CHARACTERISTICS OF VIBRATING TUNGSTEN WIRE
2 in. LONG 0.009 in. DIA.

Deflection	Octaves	Frequency per sec.	Tension psi.	Load lb.
0.00000008	0	32	2.37	0.00015
0.00000016	½	45.25	4.73	0.00030
0.00000031	1	64	9.46	0.00060
0.00000063	1½	90.5	18.92	0.00120
0.0000013	2	128	37.8	0.00241
0.0000025	2½	181	75.7	0.00482
0.000005	3	256	156.5	0.00963
0.000010	3½	362	302.9	0.01926
0.00002	4	512	602	0.0383
0.00004	4½	724	1203	0.0765
0.00008	5	1,024	2407	0.1531
0.00016	5½	1,448	4814	0.3062
0.00032	6	2,048	9695	0.632
0.00065	6½	2,896	19391	1.263
0.00129	7	4,096	38781	2.467
0.00258	7½	5,792	77562	4.933
0.00517	8	8,192	155124	9.87
0.01034	8½	11,584	310248	19.73

Note—Tabulation was made from test and recorded for half octaves

The tungsten wire in the device is surrounded by a strong transverse magnetic field, supplied by 2 Alnico II horseshoe magnets with soft steel pole pieces. Every movement of the wire perpendicular to the magnetic field will produce a small voltage across the ends of the wire. Thus, the vibrating wire produces an audio frequency voltage the same as a ribbon velocity microphone, except that the greatest amplitude of vibration of the wire (and voltage produced) will be at the natural frequency of the wire.

This tracer gives the operator an accurate control over the duplicator even when using a long flexible stylus. The basic tone of the tracer is adjusted with no pressure on the stylus, and a rubber pressure washer is adjusted to allow a predetermined deflection of the stylus without increasing the pitch of the signal, and to compensate for deflection of the cutter before it starts cutting. Any pressure exerted on the stylus above the small pre-set pressure will produce an increase in pitch of tone produced by the device directly proportional to the pressure.

In following the intricate contour of the master form, the operator tries to maintain a constant pitch in the loudspeaker. Operators on the job became skilfull in following the master after a short conditioning period with several times more accuracy than that possible by any other method. Before the tone stylus was applied many impellers had to be scrapped because the thin sections were cut through. Tool wear and breakage was also high with conventional machining methods.

DISTORTION-FREE SPINDLES

Where lathe spindles are mounted in bronze bearings, steels of the SAE 4615 or SAE 3120 type are most suitable. As the spindles are usually carburized, straightening difficulties sometimes encountered may be minimized by eliminating the carburized section from the body of the spindle, allowing the high carbon zone to remain on the bearing sections, nose section, or any other parts which must possess surface hardness. This selective carburizing might be accomplished by copper plating or else by machining of the sections after carburizing is accomplished.

Minimum distortion may also be attained by using a fine-grain steel which can be pot-quenched. Copper plating for selective hardening, followed by carburizing at a moderately low temperature of 1600-1650 F. is suggested by the International Nickel Company. After the required depth of case has been developed the pot and contents should be transferred to a second furnace or allowed to remain in the carburizing furnace with retarded temperature. The pot and contents should be allowed to saturate at approximately 1450-1500 F., followed by an oil quench. SAE 4615 is a good steel for this treatment. This is one of the moly steels, with 0.20-0.30 molybdenum and in the nickel range from 1.65 to 2:00, with a maximum of 0.050 sulphur.

If the spindle is to be mounted in ball or roller bearings a particularly hard surface is not required. Oil hardened steels such as 4650, 3150 or 2350, heat-treated to approximately 250-300 Brinell are adequate for this service.

Successful Drawing and Redrawing

THIN-METAL STAMPINGS

Chief troubles in drawing and redrawing thin-metal stampings are tearing and wrinkling, but they can be prevented by good die and product design, good workmanship and sensible care

BY WALLACE C. MILLS

METAL under 0.020-in. thickness can be drawn in dies in the same way that heavy stock is drawn. Although the drawing action is similar and the technique is not more difficult in many respects, special precautions are required because of thinness.

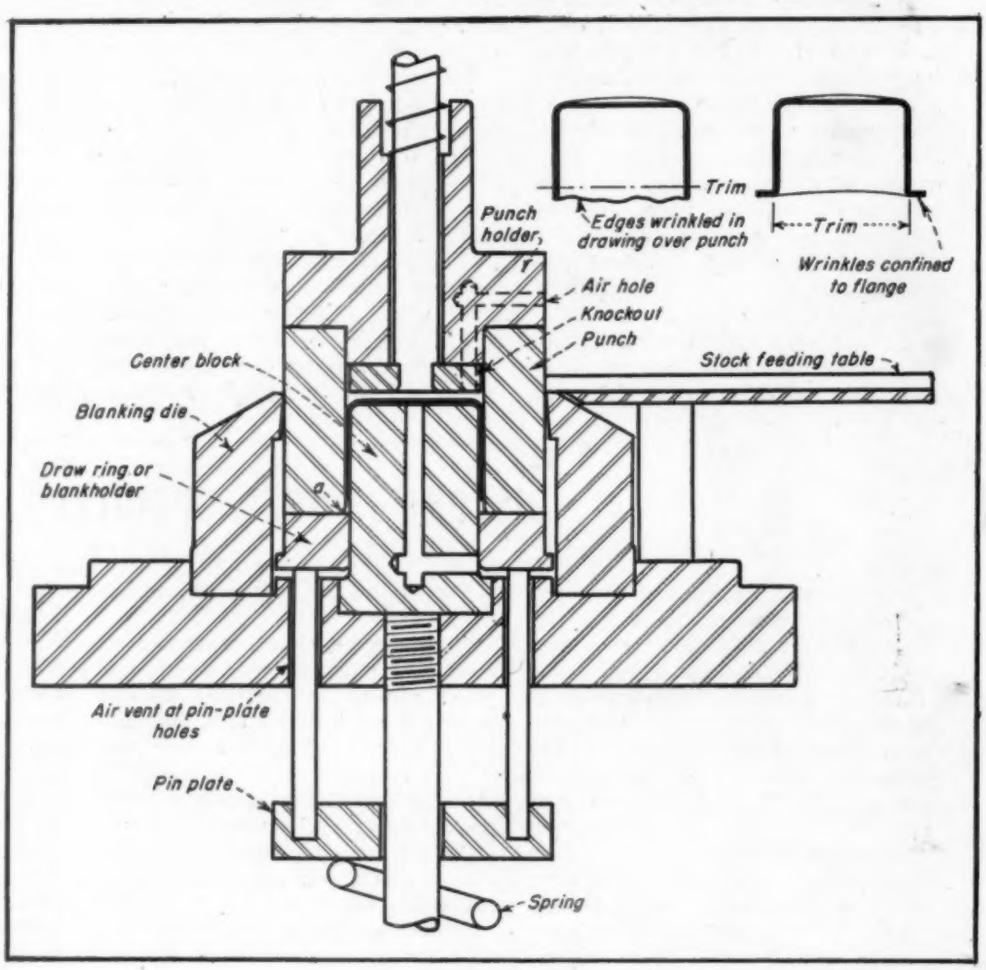
Chief difficulties are tearing and wrinkling. Thin metal is too weak for much stretching so it ruptures, and it lacks the necessary thickness to stand up in compression so it buckles, unless confined closely in dies. Both tension and compression are present, as the metal is compressed in one direction in drawing from a large to a smaller diameter and stretched in the other direction at right angles in drawing to greater depth.

Stretching strain may occur in all parts of the blank when too much drawing spring pressure is applied, or it may be localized on one side when the stock is pinched at some point. On the other hand, buckling under compression starts wrinkles unless the stock is confined.

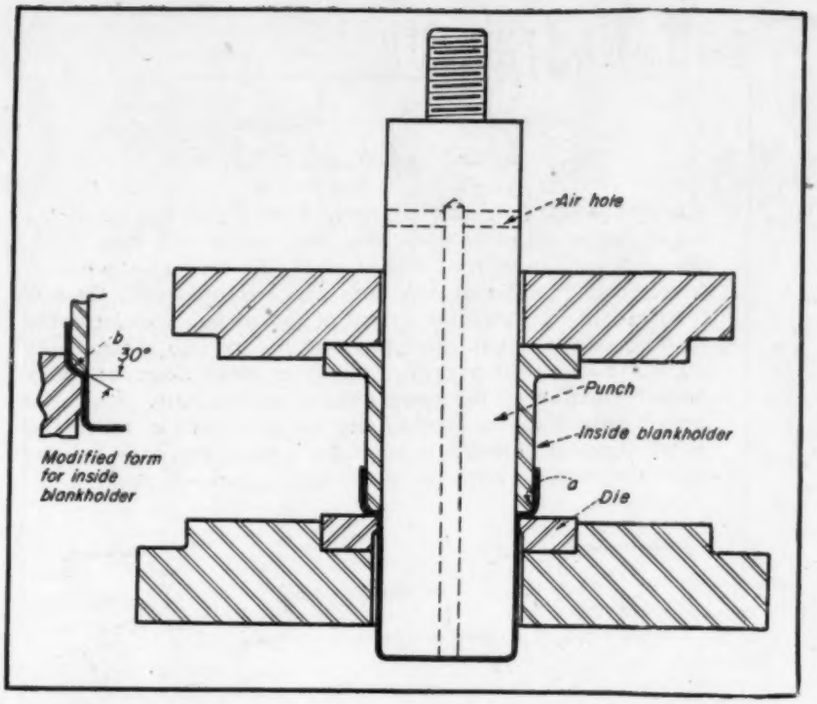
These conceptions are useful in analyzing causes of tearing and wrinkling. If the proportions and shapes of blanks for successive operations are faulty, for example, tearing occurs where there is not enough metal in the shape for reforming, or wrinkling comes from surplus stock.

In other respects, too, the technique of handling thin-metal stampings differs from requirements for heavier stampings. Many thin-metal stampings are small in size and must be handled rapidly by hand and in machines, so their shapes should be convenient for handling.

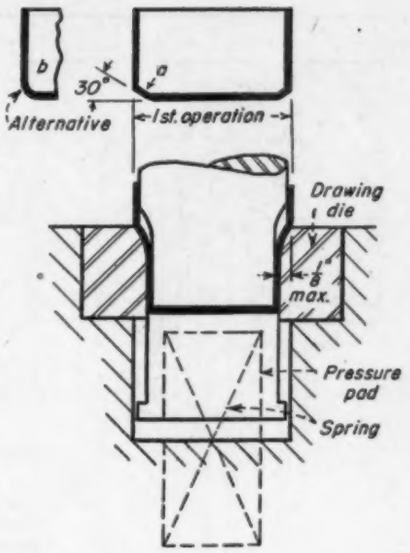
Thin-metal stampings also can



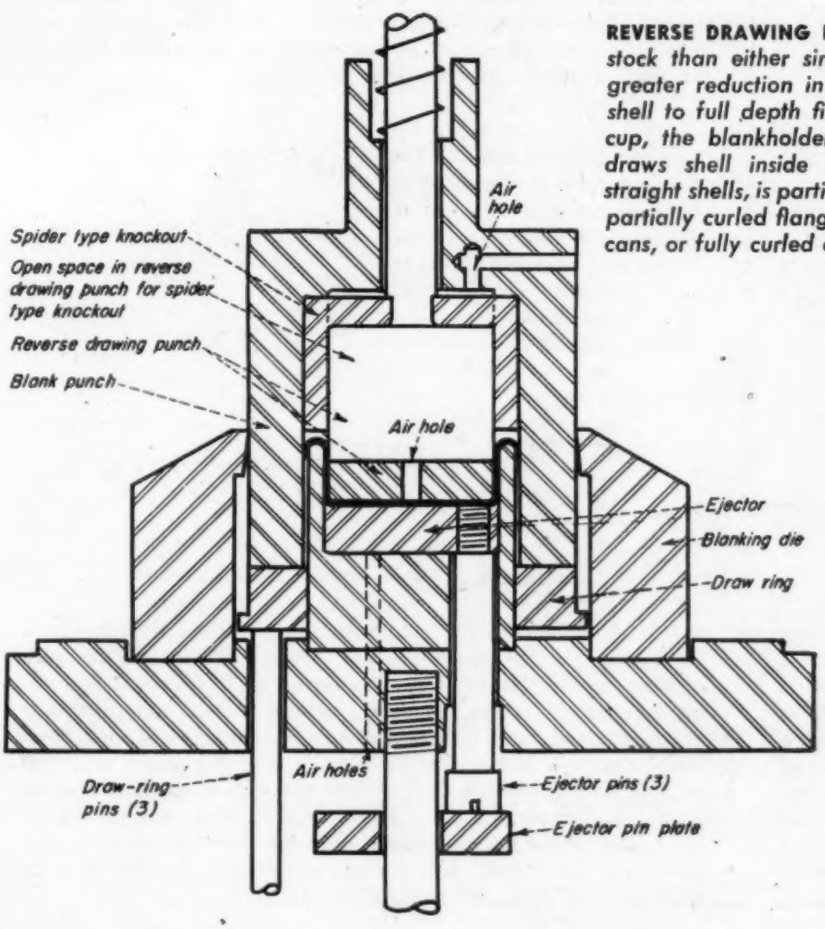
SINGLE-ACTION DIE . . *All drawing dies should have the punch drawing radius a as small as possible without tearing the stock, as a radius too large wrinkles the stock. Found by trial, it must be larger for deep draws and smaller for thinner stock. As deep-drawn shells wrinkle where the edge draws over the radius after blankholder pressure is lost, the wrinkled edge is trimmed or the shell is drawn part way and the horizontal flange trimmed. If wrinkles are not trimmed off, the shell resists redrawing at certain spots and high spots will be drawn on the edge. Edge burrs from a dull blanking die cause same condition, as burrs tend to stretch metal in drawing. Vent holes in punch holder, center block and around pin-plate pins prevent compression of air from interfering with die action or from bulging the shells*



DOUBLE-ACTION DIE . . *Redrawing thin metal demands inside support to avoid wrinkling. Push-through dies, common for heavy stock, are used only when diameter reduction is small as thin metal buckles too easily. Inside blankholder should fit the blank, including corner radius. A 30° beveled edge b, instead of radius a, may be used on the theory that drawing is easier than over two right-angle bends*



REDRAWING DIE . . *Shape of stamping may prohibit use of inside blankholder. On this flashlight hood, redrawing with no inside support is limited to a reduction of about 1/8 in. on each side. Redrawing will start without wrinkling if the drawn shell is beveled at a or has a large radius b. Shell from first draw should be the same diameter as the larger diameter of finished shell. Both diameters should not be drawn in same operation*

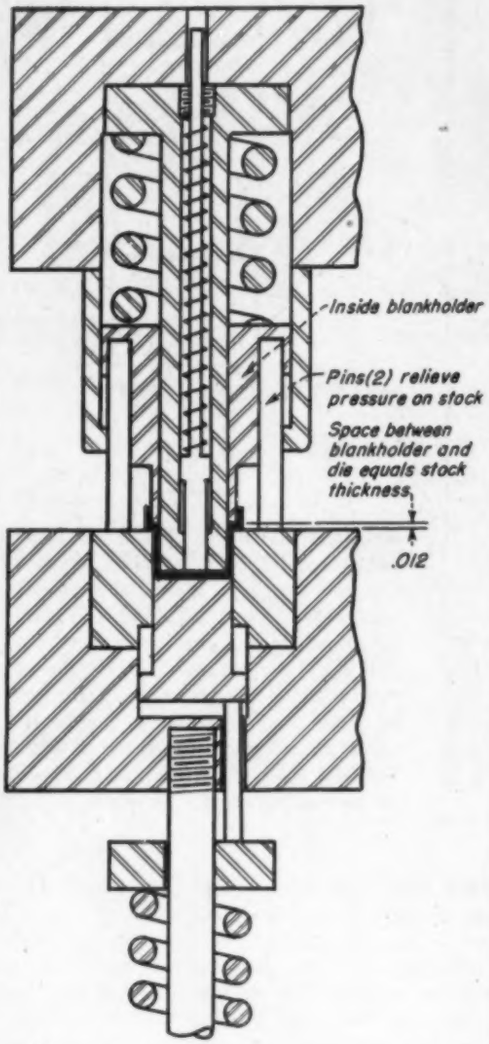


REVERSE DRAWING DIE . . *Drawing inside out is easier on the stock than either single- or double-action drawing and allows greater reduction in one operation. The drawing punch draws shell to full depth first. As it descends beyond bottom edge of cup, the blankholder releases the flange and an inner punch draws shell inside out. Reverse drawing, although used on straight shells, is particularly effective for drawing tapered shapes, partially curled flanges later flattened as in plugs for friction-top cans, or fully curled edges as in trays and pans*

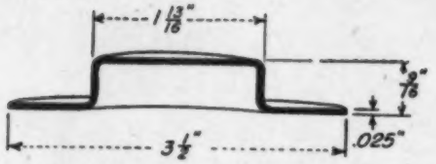
be kept comparatively clean and free from oil, unless draws are quite deep. For shallow draws, the stock can be lubricated by applying wax by spraying or by rubbing the strip stock with chunks of paraffin, thereby saving the cost of washing.

If draws are deeper, the stock can be oiled sparingly. Lard oil or a heavy lubricant thinned with paraffin oil is suitable for deep draws, and petrolatum is satisfactory for shallow draws. Problems of lubrication, press speed, annealing and wear are not as serious as for heavy stock.

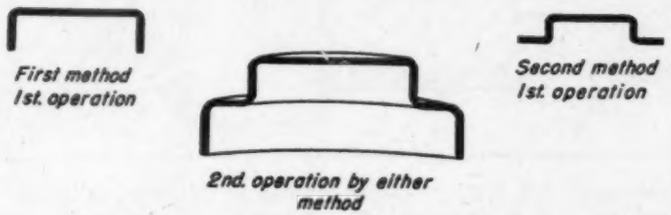
Blank shapes for a series of operations, when there is doubt about blank proportions, are developed by trial in experimental dies before permanent dies are built. For determining shapes and designing tools with least error, certain rules have



PIN DEVICE . . To relieve pressure on stock and maintain a constant space between blankholder and die equal to stock thickness (in this die. 0.012 in.), two pins hold the inside blankholder at correct height by contacting surface of drawing die. As the punch descends, pressure on stock is held constant in single-action die, obtaining same effect as in double-action drawing

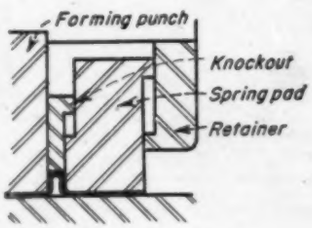


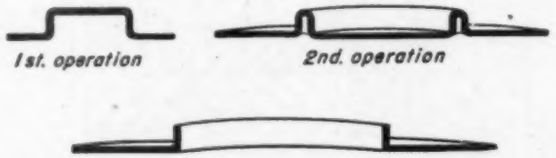
FLANGED SHELLS . . Hub diameter may be drawn to about 0.6 × flange diameter while hub depth varies with stock thickness, about 5/16 in. for 0.012-in. stock. To draw in one operation, drawing radius at hub base was increased until the hub fractured at top, then the radius at top of hub was increased to balance the strain. Redraws may reduce hub diameter by 20% and to almost any size as long as metal does not strain-harden. Redrawing will cause wrinkles at hub base. If wrinkles are objectionable, the product may be redesigned as two pieces joined together. If radius at hub base is too sharp, extra forming operations will be required; if too large, stock will pucker

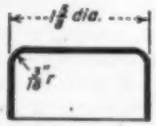


TWO-DIAMETER SHELLS . . Drawing the finished shell in one operation would cause wrinkles. It can be made by drawing a shell first and then drawing a hub on the shell. By the second method, a hat-shaped shell is drawn first and the outside flange drawn down in a second operation. Latter method makes handling more convenient in subsequent operations, because hat-shaped shells do not turn over or roll easily. Shallow hubs, as in a panel, can be drawn in one operation by striking hard at the end of stroke to flatten small wrinkles

DRAWING OVER AIR . . The finished form is produced in two operations. The hub is drawn first and then drawn inside out, over air, in a second operation. If the deep bead were drawn in one operation, the metal would lock in the die at the bead and probably rupture







1st. operation

2nd. operation

TWO-OPERATION CAP . . This flashlight cap has too many steps for drawing in one operation. It is first drawn cup-shaped with a large radius to provide surplus stock for forming of steps in another operation. The first-operation cup should have the finished diameter so no redrawing is combined with reforming

INTERIOR FLANGES . . When a hat-shaped shell is drawn and the bottom cut out, the horizontal flange will be wavy because of metal strain. Camber can be removed by bumping or by turning the outside edge. Another method draws hub part way down, center-blanks hub and draws remainder of flange from interior metal. Holes must be clean cut or the metal will split at points of incipient cracks. When the hole is at least 3 in. in diameter, flange not over 5/16 in. high and stock 0.015 in. thick, the whole interior flange may be drawn from around a hole in a flat blank. This method saved considerable stock in drawing end rings for ammunition cans

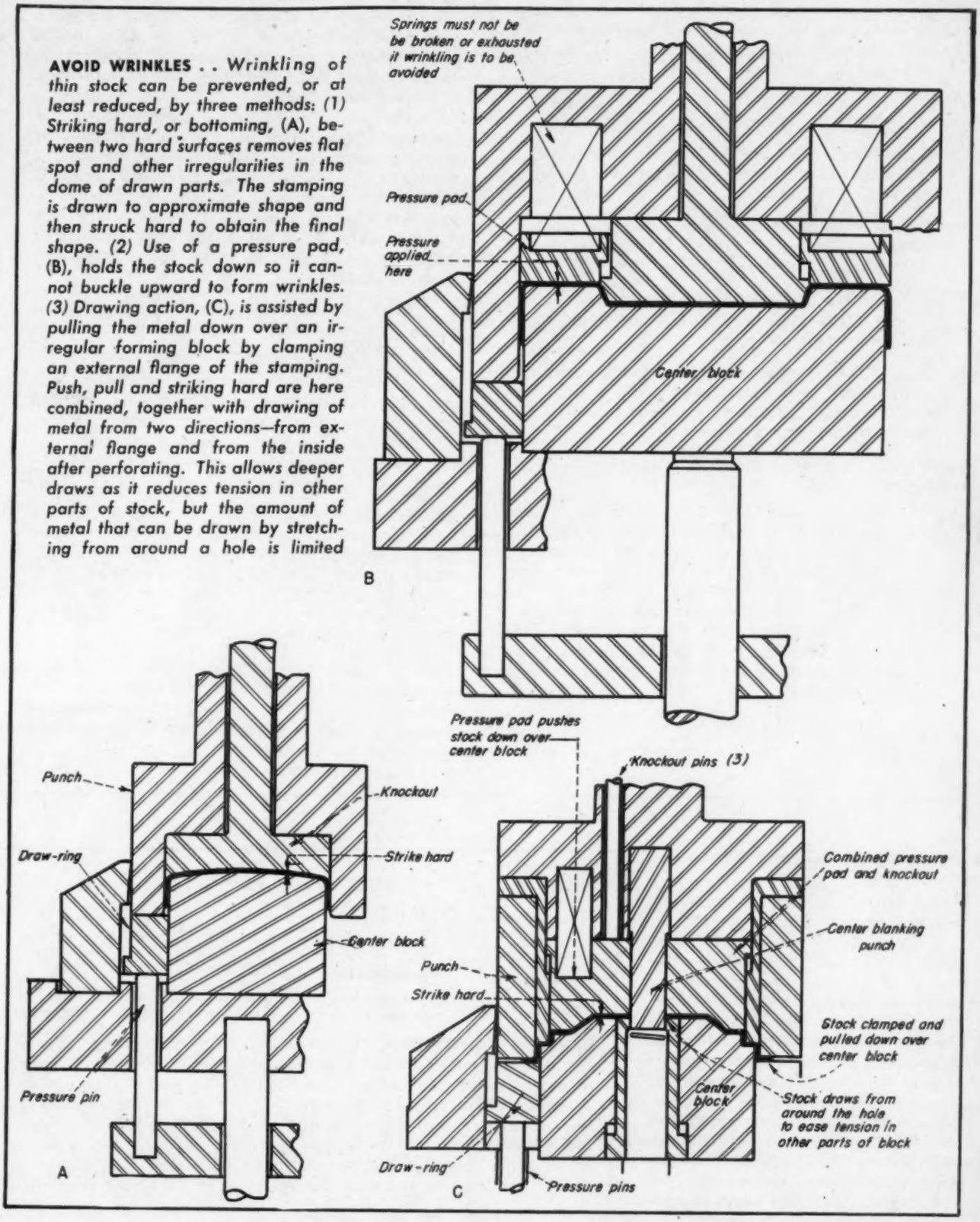
been found practical. These rules, while similar to those for heavier stock, differ in some respects. The amount of draw that can be made in one operation, for instance, is less for thin stock.

Depth of draw for stock under 0.020 in. in thickness may be 0.7 times the diameter of drawn shell for the first operation. Reduction in diameter for each succeeding redrawing operation may be 20% of the diameter. Depth of draw in three operations is twice the diameter plus allowance for trimming. This rule may be modified slightly for conditions such as the following:

1. Small cups, 1 in. in diameter and 1 in. deep of 0.010-in. steel, can be drawn in one operation.

2. Double-action drawing produces less strain than single action. The stock is confined to a definite space so it cannot rise to form

AVOID WRINKLES . . *Wrinkling of thin stock can be prevented, or at least reduced, by three methods: (1) Striking hard, or bottoming, (A), between two hard surfaces removes flat spot and other irregularities in the dome of drawn parts. The stamping is drawn to approximate shape and then struck hard to obtain the final shape. (2) Use of a pressure pad, (B), holds the stock down so it cannot buckle upward to form wrinkles. (3) Drawing action, (C), is assisted by pulling the metal down over an irregular forming block by clamping an external flange of the stamping. Push, pull and striking hard are here combined, together with drawing of metal from two directions—from external flange and from the inside after perforating. This allows deeper draws as it reduces tension in other parts of stock, but the amount of metal that can be drawn by stretching from around a hole is limited*



CAUSES OF TEARING OR WRINKLING IN THIN METAL

1 . . Stock ruptures if the draw is too deep or if reduction by redrawing is excessive.

2 . . If the amount of stock drawn into a hump for reforming in a subsequent operation is too little, the stock tears. If it is too much, the stock wrinkles.

3 . . Incorrect shape of a blank for redrawing can rupture or wrinkle stock.

4 . . If the corner radius of a drawing punch is too sharp, the stock tears. If the radius is too large, the stock wrinkles.

5 . . If the corner radius of a forming block is too sharp, the stock breaks in bending over a sharp corner.

6 . . Spring pressure on a blankholder, if too strong, causes rupture. If the spring is too weak, the stock wrinkles.

7 . . If the clearance between drawing punch and center block is too small so the die is tight, the stock will tear. If the clearance is too large, the stock buckles and wrinkles.

8 . . High spots and lack of concentricity of die parts:

(a) On new dies, high spots from poor workmanship cause the stamping to draw more deeply at certain points because of pinching.

(b) On old dies, low spots from wear cause a localized pressure that tears the stock, or the wear causes excessive clearance so the stock wrinkles. Certain parts of dies wear faster than other parts, particularly in rectangular dies which wear faster at the four corners. The remedy is to true up the die.

(c) Foreign substances, scrap metal in the die, grit, scale or loading of the drawing punch with particles of metal cause tearing.

(d) Dies may stick because of poor workmanship, foreign substances, broken springs or lack of air vent holes.

(e) Lack of concentricity of the die parts makes the die too tight on one side. Dies should be designed to maintain concentricity after the die parts have been sharpened and shimmed up, as by concentric surfaces.

(f) Lack of parallelism of drawing punch and blankholder, because of unevenly distributed spring pressure on the blankholder or because of flexibility of the blankholder, causes localized strain. For example, in drawing a rectangular pan, wrinkles may develop at corners of a pan if the blankholder is not supported by springs at its corners and springs away from the punch drawing surface.

9 . . Friction from inadequate lubrication, lack of polish on the drawing surfaces or tool marks may cause tearing.

10 . . Defective stock can cause trouble. Stock may vary in thickness or hardness, or have hard spots or poor drawing quality. Sheet stock cut into strips is often used, instead of coil stock, for thin-metal stampings because of the saving in material cost, but its thickness varies.

11 . . To prevent incipient cracks from tearing open, clean-cut perforated holes or trimmed edges are necessary if the stock is to be redrawn. Dull blanking tools raise burrs on the edge of stock. These burrs retard the drawing action and cause the stock to be drawn to greater depth where the burrs are most prominent.

12 . . Products may be designed to use pieced construction when integral construction is impractical because of tearing or wrinkling. Pieced structures are not difficult to assemble—and a tin can costs less than a drawn shell.

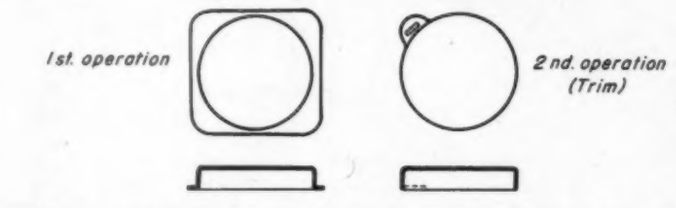
THIN-METAL STAMPINGS continued

wrinkles as it is drawn from between blankholder and die.

3. Single-action drawing is more likely to rupture stock because the metal is held by spring pressure which increases with depth of draw. The pressure is more constant with air cushions, but springs are more convenient for small stampings.

4. A pin device may be used in single-action presses to relieve pressure on stock and maintain a spaced relation between blankholder and die, thereby obtaining the same effect as double-action drawing.

5. Depth of draw may be increased by reverse drawing.

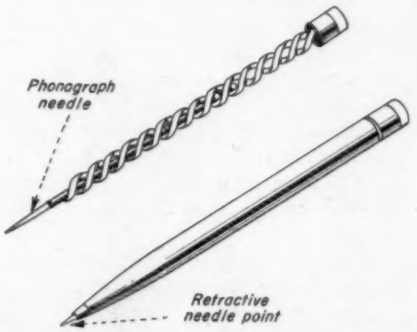


HANDLING CONVENIENCE . . *Pressworking of small thin-metal stampings demands convenient handling shapes. A center hole allows piloting, or a hub can be centered by cone-shaped spring pad or from outside. A first-operation symmetrical shape, formed later to the required irregular shape, speeds production as the work does not need to be spotted in a certain location in the final operation. Hand feeding to dies is faster if the operator can feed stampings open end up. Thought on shape, position and centering devices pays off in higher production*

Short Cuts FOR THE SMALL SHOP

BY A. H. WAYCHOFF

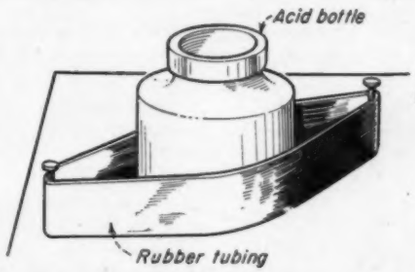
PRUSSIAN BLUE is more easily dispensed a little at a time from a grease cup than from the original tube. Make a gooseneck of strap iron, drill two holes in one end for rivets and a larger hole in the other end to receive the grease-cup outlet. Rivet the gooseneck to an iron plate, assemble the grease cup in place and fill with prussion blue. Now, to get a little blue on the fingers while lapping or fitting small parts, place them under the grease cup and turn down the cover slightly with the other hand.



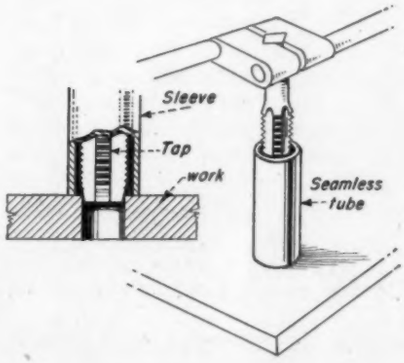
A POCKET SCRIBER that won't prick the user can be made from an old automatic pencil. Take out the mechanism, solder a phonograph needle to the lead gripping unit, replace in the pencil body, and the scriber is ready for use. A turn or two of the barrel pushes out the scribing point; retraction permits the gadget to be carried safely in the pocket.

RUST AND BURRS can be removed from square, hexagon and round bar stock and shafting, by use of a worn-out file with appropriate notches

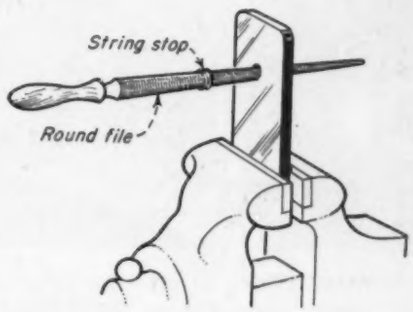
carefully ground in the edges. An assortment of V, hexagon and round openings are required to make a tool, which is often superior to a blade scraper.



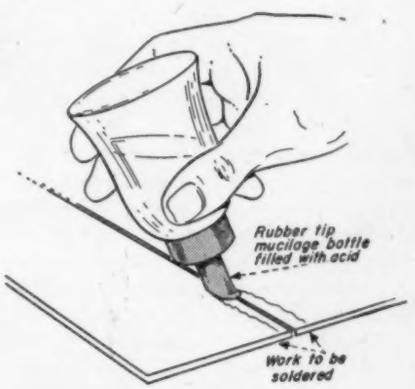
A BENCH HOLDER for bottles of acid, glue and other fluids can be made from a section of automobile inner tube. A piece a couple of inches long is stretched taut over two nails driven into the bench at a suitable distance apart. Then the bottle is placed in the taut rubber "band," where it is held securely against bumps or vibration.



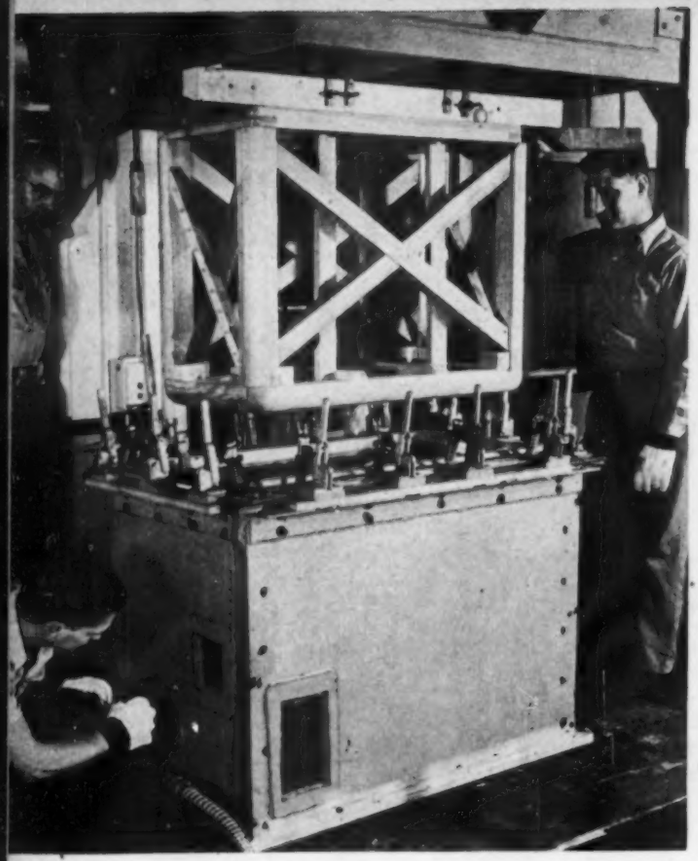
SMALL TAPS are less likely to break when started in a hole, if a closely fitting tube with a square end is slipped over the tool. If possible, grip the tube with the fingers of one hand, pressing the square end firmly against the work, and operate the tap wrench with the other hand. By use of the tube, less strain is put on the tap and there is less likelihood of bending and breaking it.



A STRING STOP on round or square files will avoid the file wedging in the hole and will save one's temper. Wrap several turns of common twine around the file at a point where it will not stick in the hole, enlarge the hole, move the string stop back, and repeat until the hole is suitably enlarged. Sometimes a coil spring can be used instead of the string.



AN ACID SWAB, which lays down just the right amount of fluid along a seam to be soldered, can be made from a mucilage bottle fitted with a rubber grip spreader. It is best to take a fresh bottle of glue, clean out the contents and refill with acid, because the rubber spreader is often distorted after much use in spreading glue. A further advantage of the bottle is that there is nothing to corrode and it will not leak readily



CONSTRUCTION of mold for ridge-forming transparent plastic parts may be of wood and is of a skeleton type. Spring-tension toggle clamps hold the material across the opening while the press ram lowers the mold into this opening for a predetermined distance

RIDGES run along the dimensions of this sheet-metal punch to form a rectangular housing with very slightly rounded corners. This is the only contact with the plastic sheet and prevents any scratching of the surface outside of the bends

Ridge-Formed Sheet Eliminates Polishing

BY W. W. FARR, SUPERVISOR, SALES SERVICE
AND R. TOMLINSON, SUPERVISOR, FABRICATION LABORATORY
ROHM & HAAS COMPANY

SHEET PLASTICS may now be formed in production quantities for such parts as housing, shields, cases or covers for electrical equipment by using a skeleton mold rather than a solid metal or wood mold. This technique, known as "ridge forming" was developed by Rohm & Haas Company, and requires that a mold make contact with the heat-softened plastic at major shape-determining points. As a result, finishing costs have been greatly reduced in the production of large numbers of identical plastic parts by elimination or reduction of subsequent polishing.

Small quantities of different designs produced by this method are feasible and economical because the individual mold need only be a framework of the mold. Most valuable application to plastic sheets is of course in the forming of transparent sheet products.

The ideal way of forming a curved part from a transparent acrylic sheet part is to clamp the sheet across an opening having the contour required in the base of the finished part. "Free-blown" parts of this type have fine optical properties since the shaped portion of the plastic is in contact with nothing but air during forming. "Free blowing" has its limitations and shapes produced tend toward the spherical and a limited control of contour is possible.

Plastic sheet products may be drawn in skeleton-type molds that make contact at critical shaping points only. This cuts mold cost and prevents marring

Ridge forming is thus a compromise between this ideal but limited process and the solid mold forming. The typically high first cost on large molds is greatly reduced and the function of the formed piece is enhanced.

Ridge forming, a modification of stretch forming, employs a mold that touches the plastic at only those points which determines the final shape. In forming a rectangular plastic housing the heated sheet is clamped across an opening just a little larger than the horizontal cross-section of the part. Then a framework having the length, width and depth of the required housing is inserted and pressure is applied to force the sheet down to the shape of the mold outline.

The completed housing, having

been in contact with the mold only along the various edges and corners, shows no surface marring except on the inside of these sharp curves. In these small areas the light reflections are such that considerable markoff may be present without affecting the function of transparency.

In some cases, a wooden box-like form serves most conveniently as the body of the mold. It is made slightly smaller than the part being formed and may be left relatively rough. Strips of hardwood, Masonite or metal are attached to the form in the places where contact with the plastic is required. The strips are always given a polished finish.

Shallow parts may be formed merely by pressure on the mold. If the draw is more than half the width of the opening, vacuum forming should be first used to draw the plastic to a "free-blown" shape a little deeper than required depth. The mold is then inserted and vacuum released to allow the hot plastic to snap back and cool around the mold outline.

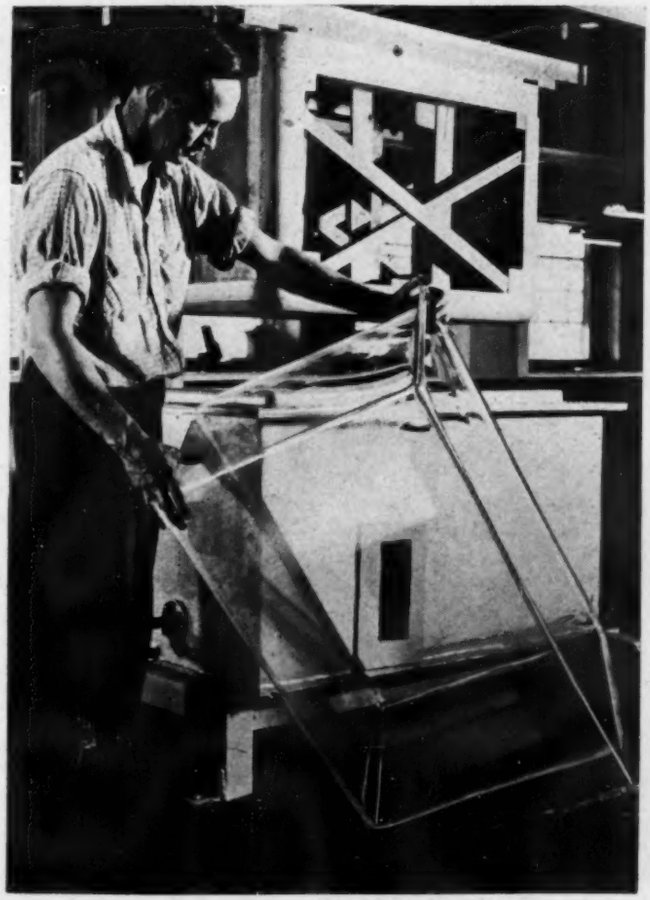
It is also possible by ridge forming to draw different sections of a part to different depths. Ridges in the inserted mold press the plastic against corresponding grooves or ridges in the vacuum pot to permit differential drawing. This type of drawing was recently adapted to the joining of the nose section of a large Sikorsky helicopter. The assembly comprised six curved Plexiglas panels, two each of three different shapes. By differential ridge forming it was possible to draw two of the three pairs from a single sheet of plastic in one operation. When the formed sheet was cut along the ridge lines, four panels, free of markoff, were obtained.

Multiple-forming of identical parts is another function of the ridge-forming process and the ridges required to produce the individual shapes make natural dividing lines for sawing the pieces apart. In some designs single units that, because of their shape cannot be formed easily by ordinary free-draw methods, are produced quite readily when made "two-at-a-time" with ridge forming.

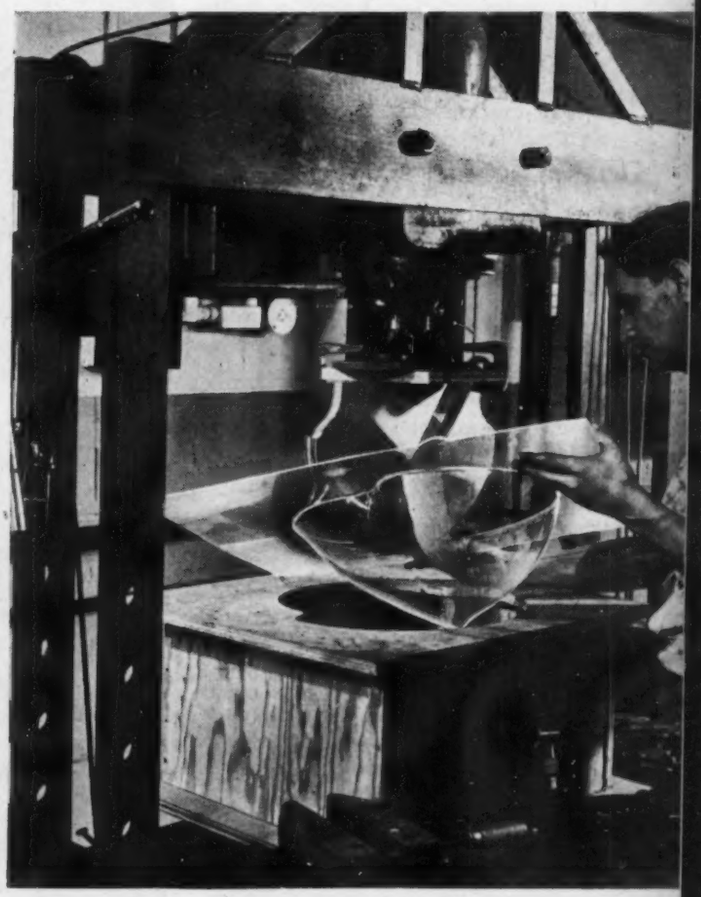
Reverse curves can also be produced by using drilled skeleton molds to which vacuum lines are attached for final shaping of the plastic after the main drawing operation is completed. The mold is first used in the usual way to stretch the plastic to the general shape required. The vacuum in the mold is then turned on, drawing the sheet in around the mold contour. This method can be used only in designs which will not lock in the mold in the final vacuum drawing.

Hot ridge forming is a variation of the technique and is useful where a deep draw is required with a minimum of thinning out. Here the mold is fabricated of pipe (chrome-plated or smooth, stainless steel is preferred) and assembled so that steam can circulate. When the sheet is being drawn hot water flowing through the pipe outline keeps these sharp bend sections of plastic softened so the material can slip by the ridges and equalize the thickness of the various portions of the part.

DEEP DRAWS may be made by ridge forming, using a simplified selective contact mold made of wood. Here the draw is 22 in. in this 36 x 18-in. X-ray laboratory tank. Over-all polishing is eliminated, but some buffing may be necessary along the contacting lines



MULTIPLE FORMING of identical plastic units is possible with ridge-forming punches. This simple wooden punch imparts a natural dividing line for the saw to follow in separating the parts



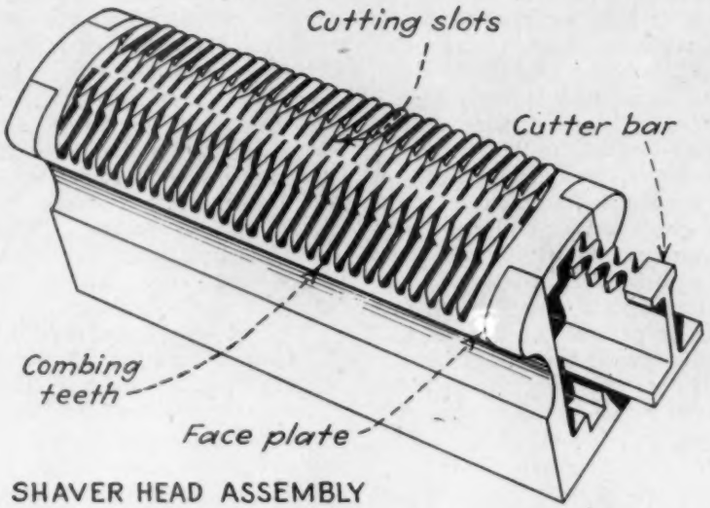
Hair-line Precision in Shaver Making

BY WALTER RUDOLPH

ELECTRIC shaver manufacture at Collman Manufacturing Company, Erie, Pa., utilizes standard milling machines but requires maximum precision in design and construction of loading and milling fixtures. Two shaver parts, the faceplate, which comes in contact with the users' skin and the cutter bar, which reciprocates back and forth underneath the faceplate, involve about 40 operations most of which are milling.

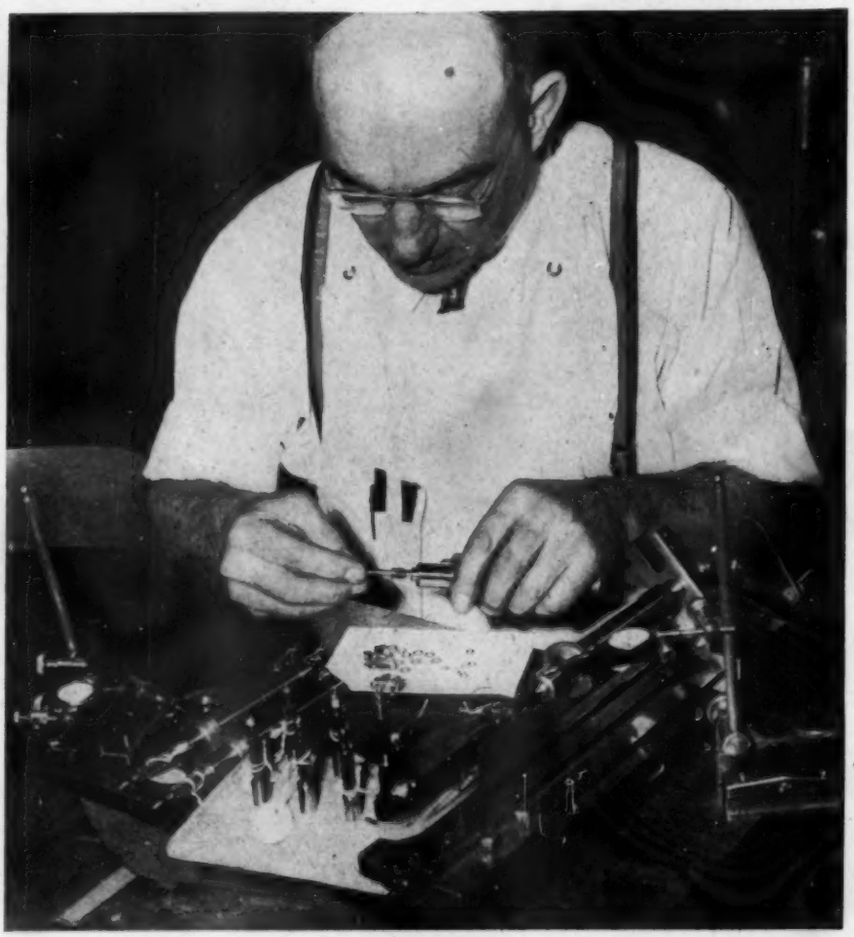
Assembly loading of arbors for multiple cutting and loading operations is one of the means by which the company engineers maintain small-parts precision in production quantities on standard millers and grinders, some hand-operated. Slotting cutters are bought at commercial tolerances, but must be lapped to within 0.0001-in. thickness variation before arbor assembly with spacers. Cumulative error in one arbor assembly for slotting cannot exceed 0.001, the assembly comprising 29 cutters and 28 spacers.

Other requirements in shaver manufacture are that the cutter bar be slightly harder than the tool-steel faceplate and that the cutter track in the faceplate must be ground after hardening for optimum straightness to guarantee faultless reciprocation of the cutter bar. Buffing and lapping and a final chrome plating of all but the cutting edges are the final operations on the shaver head. Chrome plating does not exceed 0.0002 in.

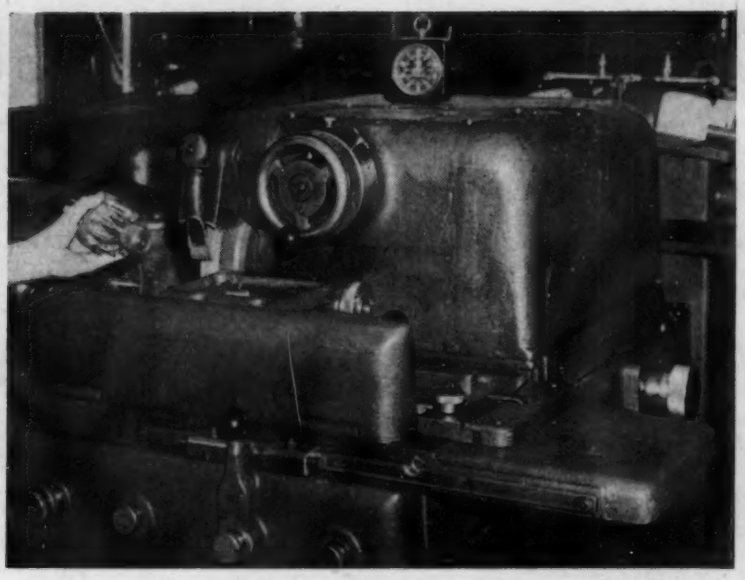


SHAVER HEAD ASSEMBLY

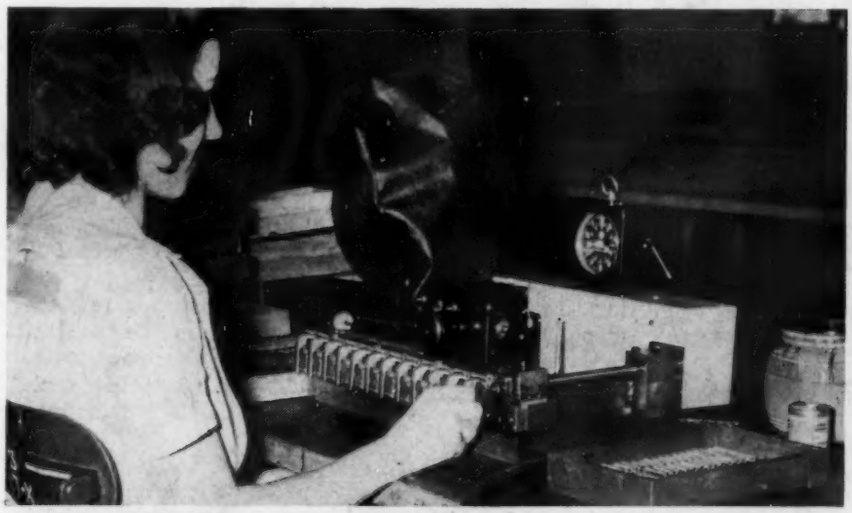
COMBING TEETH and slots are milled into the tool-steel faceplate in staggered fashion to keep whiskers from sliding through and being missed by the cutter. The 58 double-cutting teeth are precision ground from surgical steel and give a double-cutting action in each of the 58 cutting slots. Two 1/8-in. spots are drilled in the cutter bar for insertion of springs and pins that press the cutter bar against the 0.0025-in. faceplate



CUTTER ASSEMBLY for milling faceplate cutter slots comprises 29 cutters and 28 spacers on a 0.156-in. O.D. arbor, held in place on a keyway. Cutters are 0.009 in. thick, spacers 0.026 in. thick, the assembly totaling 0.989 in. Variation in thickness of the assembly should not be more than 0.001 in.



LEFT—COMBING SLOTS, which guide whiskers into the cutting slots, are milled on the top side of the faceplate. Cutters are lapped within 0.0001 in. Adaptations and special jigs enable operators to turn out 120 faceplates an hour on hand millers. After each thousand faceplates, the assembly is checked for regrinding and reassembly. Over-all size of cutting-arbor assemblies is checked by Jo blocks. Right—After cutter tracks are lapped to give optimum track straightness, the shaver head is precision-ground to 0.0025-in. thickness on the part which slides along the user's face. Special arbors are loaded with eight plates for cylindrical grinding



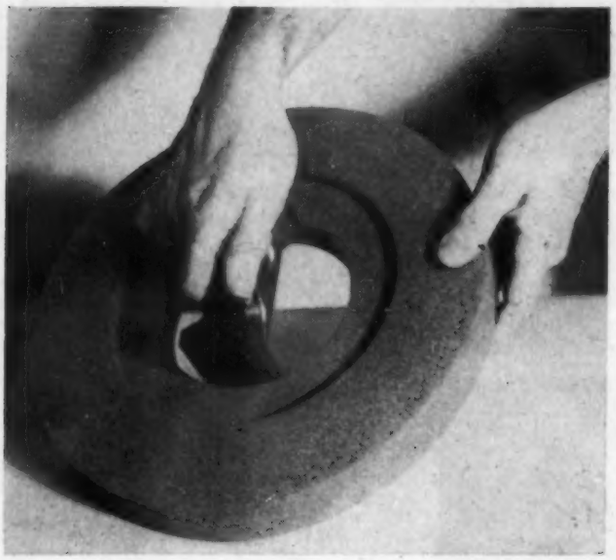
TWELVE SHAVER HEADS have the cutter lapped into the faceplate simultaneously on this multiple-head loading fixture. Cutters are press-straightened so the cutter will fit into the retainer with a 0.002-in. maximum clearance. A load of heads is lapped in a continuous cycle of about 4 min.

THE ASSEMBLED SHAVER, now including the plastic housing and electric motor with oscillating arm, is checked on a stroboscope for alignment of cutter bar. With the shaver in operation, the cutter bar should make a complete passage of the cutting slots with each oscillation. Faulty alignment and action is corrected by micrometer screw

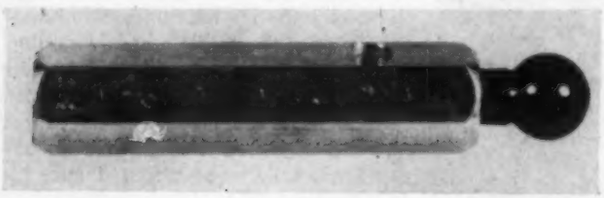
Hardest Man-Made Material

During the past several years, boron carbide has been applied to a variety of metalworking operations. Here are described its characteristics and typical uses

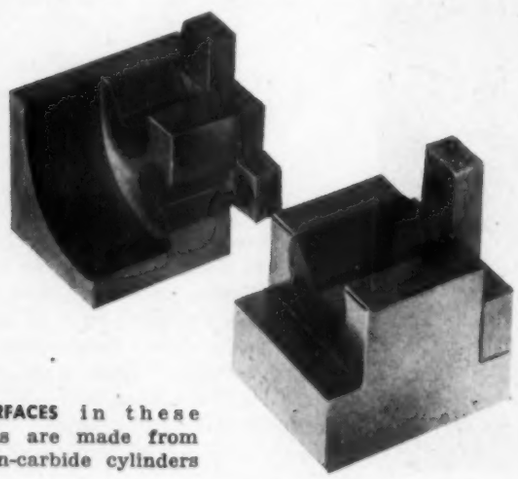
SOLID boron-carbide cylinders may be inserted to provide V-block gaging surfaces —as in the bearing-race inspection unit at center. Surrounding it are master height blocks with boron-carbide inserts



BORON-CARBIDE INSERTS provide extreme wear resistance on gaging surfaces, as in this gage for checking center holes in grinding wheels



THIS GAGE measured a million and a half ball-valve seats—a job on which steel gage wore out in 8 hr.



V-SURFACES in these gages are made from boron-carbide cylinders

AS LONG AS a dozen decades ago, men began serious experiments to synthesize nature's hardest (and then most valuable) material — the diamond. Antoine Lavoisier claimed success, but couldn't prove it; other French experimenters failed. In 1880, England's J. B. Hannay claimed to have made a diamond by heating 90% paraffin spirits, 10% rectified bone oil and metallic lithium in an iron cylinder. Henri Moissan duplicated the experiment in 1884, but his results caused him to doubt those claimed by Hannay. Recent attempts to synthesize the diamond have been no more successful.

Man's attempt to equal or surpass nature in developing abrasive materials has been more fruitful—the manufactured abrasives aluminum oxide, silicon carbide and boron carbide are considerably superior to the garnet, emery and corundum found in the earth. Silicon carbide was first produced in 1883, aluminum oxide at the turn of the century.

Development of the cemented carbides in the early Thirties, however, created the need for an abrasive harder than either aluminum oxide or silicon carbide. The first answer was a diamond wheel using crushed bortz for cutting grains. It employs diamonds unfit for gems as abrasive grain—and has proved so successful it has reversed diamond-mining procedure. Today, the great diamond mines are worked mainly for bortz.

Electric-furnace Product

The second development, made before the war by Norton Company, was boron carbide, sold under the trade name "Norbide," which, like more-familiar carbides, is an electric-furnace product. Produced by fusing the purest form of boric acid, dehydrated, with petroleum coke at temperatures around 2800 C. (5000 F.), it can be crushed to provide an abrasive grain considerably harder than silicon carbide. The same material, crushed to powder, can be molded at pressures up to 10,000 psi. and at a temperature of 2450 C. in high-heat-conductivity graphite molds—without a bonding agent. A wide variety of extremely hard

shapes thus can be obtained to close dimensions, with surface free from pores and which can be polished to optical flatness and high gloss.

Standard sizes of boron-carbide abrasive grain and flour are used for lapping dies and tools of tantalum and tungsten carbides, heretofore practical only with diamond dust costing 150 times as much. In olive, castor, mineral or vegetable oils, this abrasive is used in roughing or ripping and semi-finishing cemented-carbide wire-drawing dies and in lapping carbide tools, mineralogical and metallographic specimens, hardened-steel parts and gem stones. It is reported to give as much as 50% greater production on these jobs.

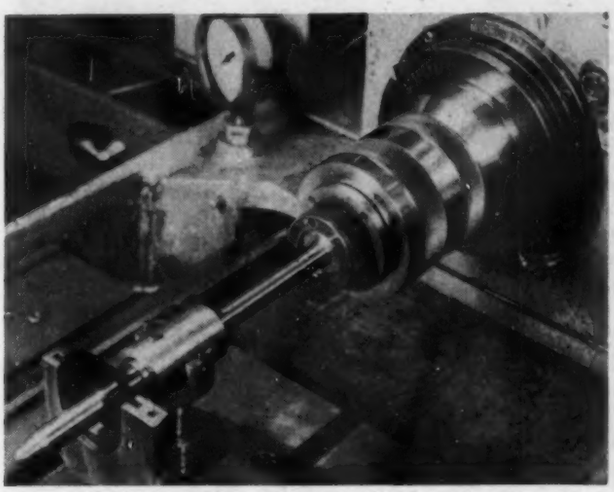
Molded forms do not have any abrading application, but other uses are legion. Boron carbide has a lower density, or specific gravity, than aluminum. It is chemically inert, unaffected by acids, alkalis or oxidizing mixtures. Its coefficient of expansion is only a third that of steel, it is stable (does not creep, work or season with age), is not weakened nor strained by processes involved in changing its shape. It does not lose its hardness, strength and wear resistance at extremes of heat and cold and will not burr or distort in use. Its modulus of rupture, however, is considerably less than that of steel.

The extremely high resistance to abrasion of molded boron carbide has brought it into use for plug and ring gages, contact points for dial indicators, anvils and spindles for snap gages and micrometers; sandblast and other nozzles; sizing guides; grinding-wheel mold liners; extrusion dies, plain bearings, and dressing sticks for toolroom grinding wheels. In gaging service, the low density of the material results in gages weighing less than half as much as steel ones. This makes an appreciable reduction in operator fatigue during a long gaging day. Fatigue, of course, impairs an operator's "feel" toward shift end.

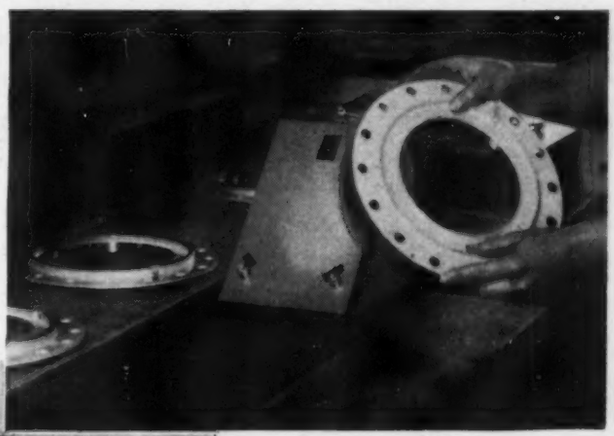
Boron-carbide plug gages were recently compared with those of other materials in a 5-mo. test in one large aircraft-engine plant. These tests indicated that annual costs of the three operations would be $15,600 for hardened steel, $11,200 for chrome-plated steel, $468 for tungsten carbide and $100 for boron carbide.

Reports show service life as high as 200 times that of steel gages, even on such abrasive materials as silicon carbide and aluminum oxide. For example, a 4-in. long plug gage of hardened tool steel required replacement every 12 to 24 hr. A boron-carbide gage, after six months of use, showed no sign of wear.

Other similar reports have been made—a steel snap gage on an internal grinder required replacement each day, a boron-carbide one was still usable after 8 mo., the "go" surfaces showing some wear while the "no go" surfaces showed none. A 1-in. dia. disk on a dial indicator checking bearing rollers leaving a centerless



WEAR SURFACE for the automatic-sizing device in a Hydro-honer is a boron-carbide cylinder set in a plastic ring



THREE rectangular boron-carbide inserts reduce wear on an angular face plate for checking truth or run-out, as well as diameter of engine flanges. It gives 6 mo. of service, compared with 24 hr. for plain steel

RIPPING and semi-finishing of cemented-carbide dies is now commonly done with boron-carbide abrasive grain and flour

PLUG GAGES for this aircraft-engine part were compared for length of useful life. Tool steel lasted 4 hr., chrome-plated gages 8 hr., cemented carbide 14 days, boron-carbide 17 mo. After 5 mo., boron-carbide showed only 0.00001 in. wear

grinder shows no wear in three years, while even tungsten carbide required reconditioning every 60 days.

Hollow cylinders of boron carbide are being used as liners in blast nozzles. In sand or grit blasting, where iron orifices will be enlarged as much as 50% in an hour or two, boron-carbide nozzles are guaranteed for 750 hr. with silica sand and twice that with steel grit before equivalent enlargement, thereby reducing air consumption 10 to 20%. Another similar application is in high-pressure water jets for debarking pulp logs.

Boron carbide is also used in two types of metallurgical compounds (which introduce boron to steel, malleable and cast iron, either in the ladle or the ingot). Boron in this case acts as a hardening agent to replace costlier and scarcer alloys.

PHYSICAL CHARACTERISTICS OF BORON CARBIDE (B_4C)

Melting point, deg. C.	2550
Density, gm. per cc.	2.51
Modulus of elasticity, psi.	65,000,000
Compressive strength, psi.	400,000
Modulus of rupture, bending, psi.	40,000
Coeff. thermal expansion (20-800C.) deg. C.	4.5×10^{-6}
Electrical resistivity @25 C., ohms/cm.	0.66
Electrical resistivity @470 C., ohms/cm.	0.038
Coeff. of friction on steel (12% Cr., Rockwell C 60)	0.17

Boron carbide is chemically inert; resists acids, alkalis, and oxidizing and reducing agents at normal temperatures. It does not absorb water nor acquire electrostatic charges (although it is a fair conductor).

KNOOP HARDNESS OF TYPICAL HARD MATERIALS
(100-gram load — U.S. Bureau of Standards)

Agate	640
Quartz	820
Garnet	1360
Aluminum Oxide	1860-2050
Synthetic Sapphire	1950
Tungsten Carbide	2470
Silicon Carbide	2500
Boron Carbide	2800
Diamond	6500

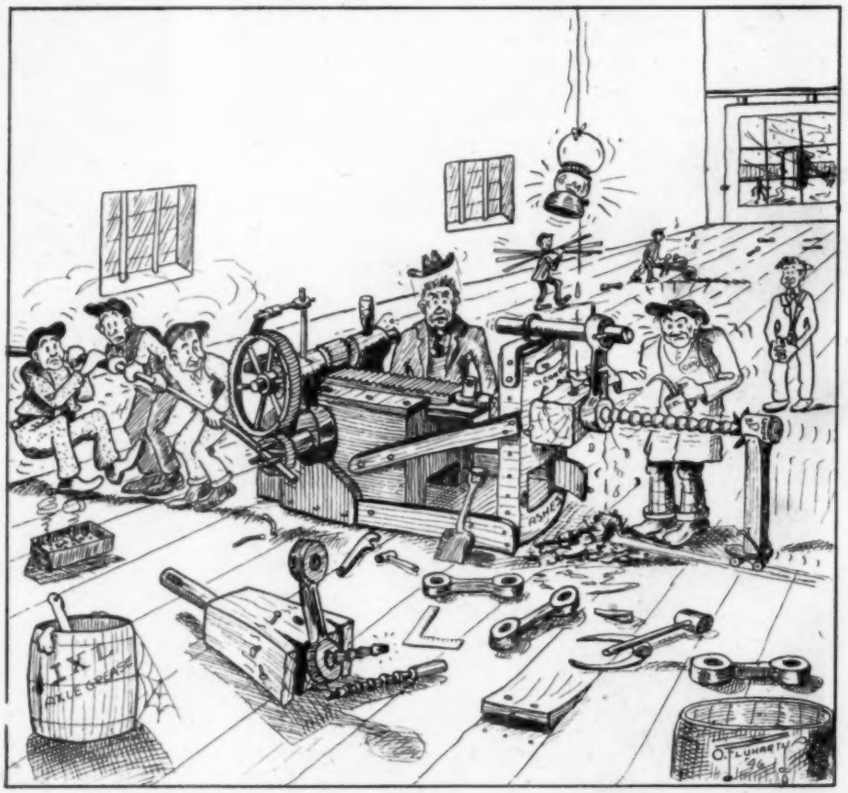
TIPS for Top Shop Men

186 Accept responsibility; don't dodge it. Superiors and subordinates both learn to appreciate the man who goes ahead with the job—and accepts plaudits without puffing and pans without hunting a goat.

187 Be extra careful about suggestions. Other things being equal, accept new ideas and be sure the originator gets credit. If the idea is impossible, be sure to take the time to discuss it with the originator and see that he understands your reasons for not accepting it—particularly that they aren't personal.

188 Be reasonable. Don't throw your weight around, or let somebody higher get you down when he throws his. Bluff and bluster never work for long—or the monkey, the puff adder and the bluebottle fly would be rulers of the earth.

OUR SHOP...25 — *Precision Broaching Dept.*



HOW TO MAKE Precision Castings

ENGINEERING

PRODUCTION

APPLICATIONS

BY
JAMES VAN VOAST
ASSISTANT EDITOR

WEBSTER says precise means "minutely exact." Scientists and engineers all know that nothing is exact, and each branch of industry has its own conception of the meaning of "precision."

When precision investment casting first jumped into the limelight a few years back, the word "precision" was taken in two different ways. To foundrymen, this method is indeed precise, for it produces parts many times as accurate as otherwise possible. Precision casters now blame themselves for allowing design engineers to start thinking of precision casting as a direct competitor to precision machining—which is to an entirely different kind and degree of preciseness.

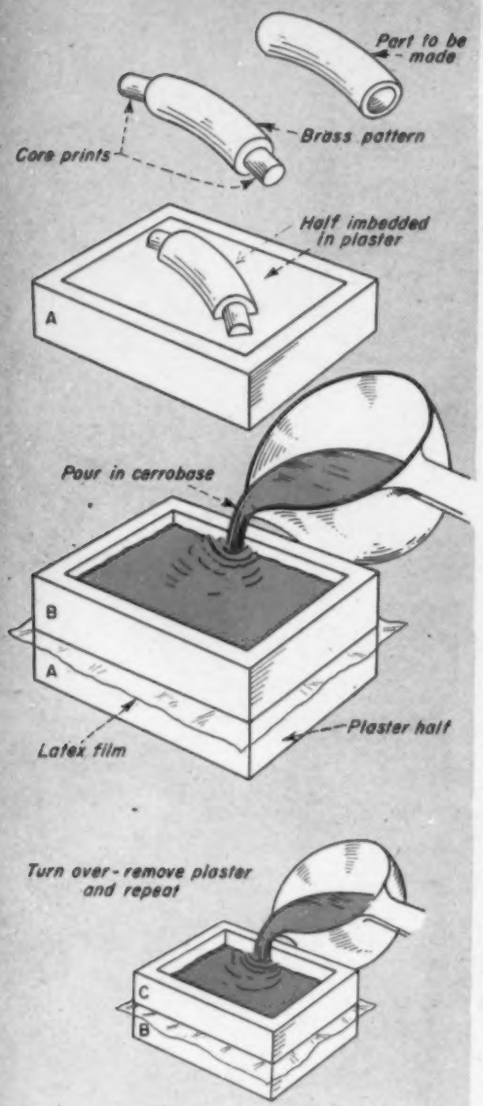
Some forty firms engaged in precision casting dropped out during 1946, including several large corporations, and veterans still in the business realize from sad experience that there is yet much to be learned about the several processes, both from the production and from the application side.

Now is the time to re-examine the factors in the light of recent developments and probable trends, and to re-evaluate both claims and actual results.

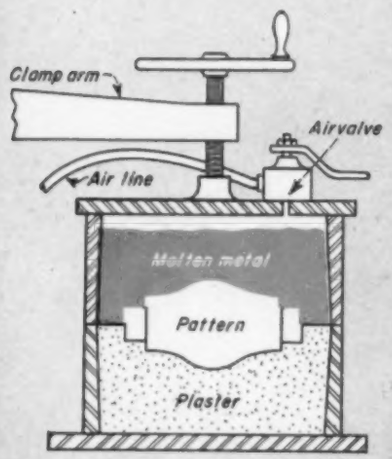
Precision casting is another tool on the metalworking team, not a competitor to machine tools in any way.

If, instead of worrying about the highest possible accuracy, standardized high-production techniques are worked out, precision casting will play its part on the team by providing sound, smooth-surfaced castings of intricate shape and contour, and leave to machines the job of finishing critical dimensions to that final precision required of machine parts.

POURING DIES



Soft metal wax injection dies are cheap to make. A preliminary plaster drag establishes a parting line against which soft metal is pressure poured. The metal half now becomes the drag, plaster is discarded and another metal half is poured. Thin latex separates halves, maintaining a smooth parting line



Flasks are quickly placed in a press where air pressure "rams" the liquid metal until it sets

SELECTING THE PROCESS

BEFORE anything else perhaps, the first thought must be about the physical nature of castings, forgings, and rolled or extruded stock to decide whether or not any of the former methods are desirable from that standpoint, i.e. homogeneity, of structure or special directional properties.

Cutting metal doesn't alter its internal structure, except possibly to release locked-in stresses in some cases. Bending, forming and forging, like rolling, extruding and drawing, cause metal to flow — fibers are stretched and the distorted metal acquires special strengths and weaknesses, and its ductility and hardness are likewise affected. Casting, by returning metal to the liquid state, nullifies any previous physical changes and necessitates a complete recrystallization. Close temperature (and pressure) control of the solidification process permits as-cast properties not possible by subsequent working or heat-treating, and precision casting not only makes smooth-surfaced and dimensionally-accurate parts but allows a degree of metallurgical control heretofore impossible.

If casting is tentatively selected, the considerations become very specific: kind of metal, size of part and quantity desired, for example. Low-priced sand castings have to be machined all over where good surface and accuracy are required. Die casting and permanent-mold casting are good methods of making precision, high-strength aluminum parts, but the higher melting-point metals from brass on up must be cast in ceramic molds.

The most plentiful and cheapest "ceramic" is common sand or silica, and foundries have relied on sand alone for many years. Sand molds can be wet or dry; after molding they may be baked to hold shapes better, or they can be poured as is, depending on moisture alone to keep them caked.

Comparatively recently, clays, gypsum and silicates have been tried in an effort to get smoother and stronger molds than sand could give. Some of these undergo a chemical reaction with water which causes them to turn to stone in a short time. Others are simply fired like pottery.

Two relatively new but well-established ceramic-mold techniques are in use. At present, they are distinctly separate in every way, but the trend is toward a combination and sharing of some basic principles. To bring out similarities, the plaster mold method and the lost-wax method of precision casting are here explained in detail side by side. The two have several major features in common which tie them together and separate them from all others. They employ a finely powdered earth-salt or rock for an investment material. This is made into a soup-like water mixture (all the materials are insoluble in water) and quickly poured around the pattern assembly, where it sets. The hardened but still damp mold is then baked in an oven from 2 to 144 hr. at from 500 to 1800 F. depending on the particular material and the size of the flask. The mold surface, when ready to pour, is just about as smooth as porcelain except that it is porous and therefore self-venting. Ovens for a precision-casting plant of any size are perhaps the largest single cost item, and so far, no investment material has been produced which doesn't have to be fired.

The similarity ends here, but not of necessity. Plaster molds are made in simple but effective automatic machines by match-plate cope and drag methods, but use of plaster limits them definitely to aluminum and copper-base alloys. Lost-wax casters use more expensive investments, especially for ferrous and special high-temperature alloys, but in many cases, the wax pattern steps are unnecessarily complicating.

Theoretically, both methods can give the same very high accuracy. Practically, both fall short of the ideal by about the same amount but in different ways and for different reasons.

Cope and drag or multi-piece plaster molds come apart for pattern removal and must be reassembled in close register for pouring. Monolithic molds produced by the lost-wax method or its variations eliminate the pattern by melting it out, and thus avoid the register problem and parting line variables.

But wax patterns have to be cast or injected in molds or dies subject to the same inaccuracies, and gains made by using precision dies are likely to be offset by wax shrinkage or distortion. Both multi-piece and

monolithic molds have certain advantages and the final choice will depend on many factors.

The Capaco (plaster mold) process, patented and licensed by Henry F. Hagemeyer, and the general technique involved in the lost wax or related processes, details of which are controlled by too many inventors to mention, serve merely to illustrate two lines of development toward the same goal, that of making smooth accurate castings. But these are only beginnings, and somewhat crude beginnings at that, judging by what competent engineers in the industry are conservatively predicting for the future. Even though these two methods can be called "well established," there is hardly a precision casting plant in existence which will not be changed radically in the next five years, and the chances are that many new plants will be built along entirely different lines.

The information in these pages is a mixture of current practice and suggestions and predictions by and for precision casters of the future.

Wax Pattern Making

THE LOST-WAX method requires one pattern for *every* casting, so the first problem is to make wax patterns at the same rate as castings are to be poured. Dies or primary molds to turn out these patterns are similar to die-casting or plastic-injection dies except that soft metal is often used because die wear is lower with wax than with metal or plastics. If the part to be cast is very intricate, with a lot of holes at different angles, undercuts, etc., the dies will have to be complicated, and have many moving parts. Draft, as customary with die casting and plastics, can be reduced or eliminated entirely, when desirable, by constructing the dies in such a way that they completely fall away from the completed pattern without forcing. Dies of this sort are usually made of hard steel for long life.

Simple parts, even with precise mathematical contours (such as turbine blades) can easily be made in soft metal (such as Cerrobase) dies which have the double advantage of low cost and quick replacement or repair in case of damage or design change. These are usually encased in steel jackets to absorb shocks and high injection pressures and to protect the parting line.

Wax pattern making is a time-consuming step; in fact it costs as much or more in labor to make a wax pattern as it does to make a metal diecasting, so it is imperative to design and build dies for rapid hand assembly or better, for automatic opening and closure when production justifies the added cost.

An appealing feature of lost-wax casting is the potential simplicity of equipment for very low production. Saucepan and cookstove heated wax CAN be ladled or poured into almost any old cavity and some kind of a pattern produced. If you're too lazy to make dies, you can make the mold out of wood . . . in fact, rubber molds are widely used in jewelry making where artistic curves are important but accuracy is not required. Even so, tiny machine parts can be wax-molded in vulcanized rubber dies with surprising accuracy and a delicacy of detail impossible by other means.

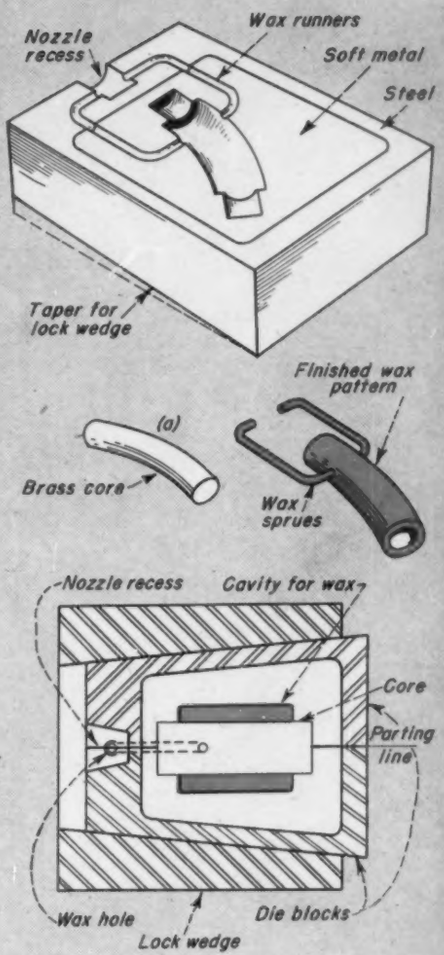
The economics of this step, like any of the rest, can be very complex. Those in favor of jacketed soft-metal dies say initial, repair and replacement cost is low, and design changes or alterations are easier. Steel die men claim theirs are more accurate and will outlive several soft dies. But it's really more involved than that. Intricacy of the part (and the die complexity required) is a big factor. When the question of multi-cavity dies comes up, a different sort of construction problem is presented.

In addition to the method of casting dies shown on these pages (which is equally adaptable to steel diemaking, by the way) dies can be machined or hobbed, depending on the shape and size of the part.

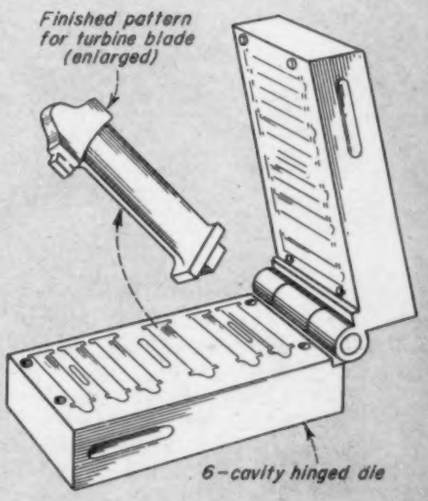
Injection Machines

AIR BUBBLES and shrinkage are the two greatest enemies of wax pattern making. Hot liquid wax static-poured into a mold will shrink a considerable but unpredictable amount upon setting and entrained or trapped air (metal dies are not porous and adequate venting is difficult to arrange) is almost sure to mar the surface somewhere. To obviate this, several procedures have been developed. Wax machines now, without exception, use air cylinder-actuated injectors, some of which are capable of filling the cavity with wax at as high as 100,000 psi. This pressure is needed because of the desirability of keeping the wax at low temperature, in the plastic

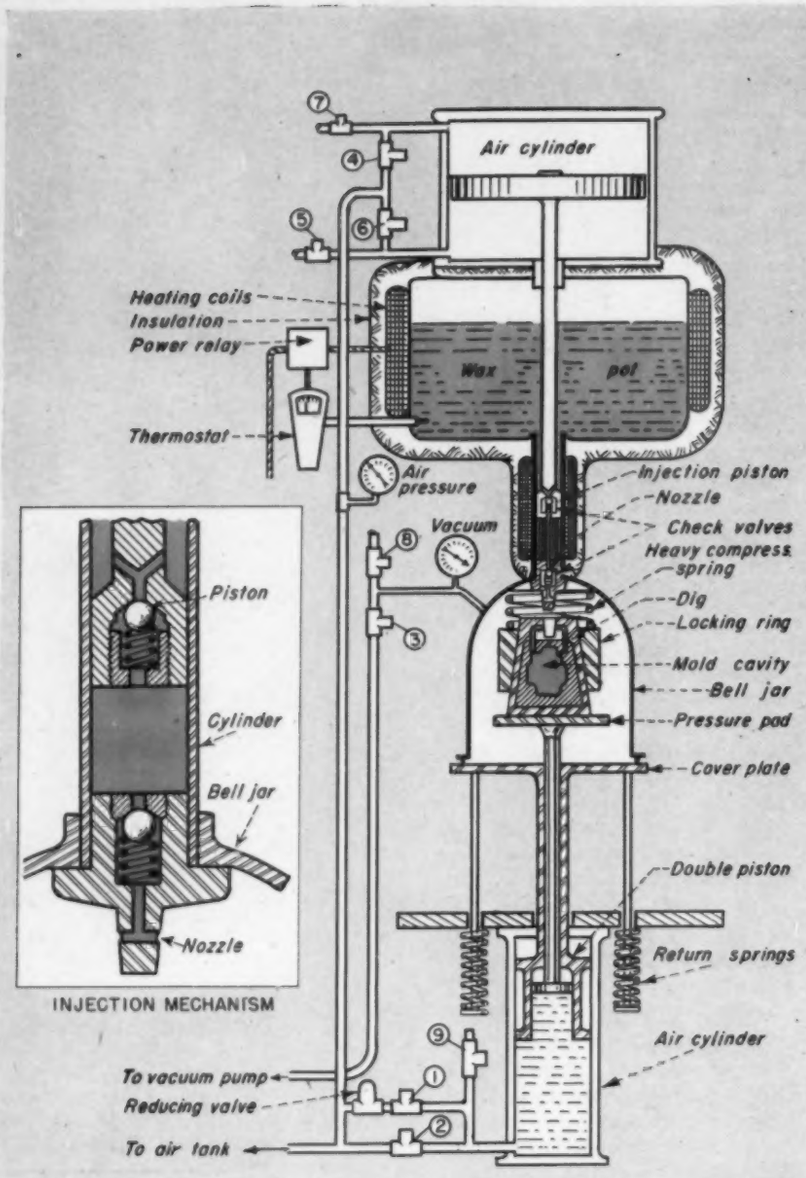
LOCKING METHODS



Hard steel die blanks protect and support the molded soft metal. Good locking must be simple and quick. One method uses tapers and end pressure—even the wax enters normal to the nozzle surface. For automatic machinery, die halves, cores and inserts all can be power-operated

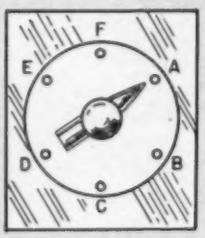


This hinged die produces six identical turbine blades in one shot. Dies are held closed with air cylinders



INJECTION MECHANISM

CYCLE CONTROL UNIT	Valves
A *Raise die*	①
B *Lock die and evacuate chamber*	② ③
C *Inject wax*	④ ⑤
D *Retract injector and break vacuum*	⑥ ⑦ ⑧
E *Drop die*	⑨
F *Off*	



AUTOMATIC INJECTION MACHINES control temperature, pressure and time for close pattern uniformity. A double-piston air cylinder closes the bell jar and raises the die against the wax nozzle, and a heavy spring pushes the tapered locking ring over the die halves. Evacuation prevents air bubbles on the mold surface. Semi-automatic cycle control frees the operator for die preparation

rather than molten state, to reduce shrinkage and to make the wax as dense and hard as possible when cold. But pressure alone, though it fills the cavity well, won't prevent air bubbles. To accomplish this, the entire die is enclosed in a vacuum chamber before injection, and the wax itself may even be deaerated before injection.

Soft metal dies are safe for high-pressure injection when adequately jacketed, but the locking method is of extreme importance. One of the simplest and quickest is the tapered ring or wedge-type lock which can be incorporated within the machine with a minimum of extra equipment and no hand work. Some machines use air cylinders to clamp dies.

For best use of low temperature and controlled high pressure, it is necessary to keep the closest possible control over the wax temperature (within 1 F). If temperature is allowed to drop, the wax will congeal and the injector will fail to fill the cavity. If temperature goes up, the wax will shrink badly on setting.

The injected pattern should be cooled in the die under pressure for from 30 sec. to 5 min. to prevent warping from uneven contraction.

Injection machines take many shapes. Some merely displace wax from the heating chamber or pot by applying air pressure above the wax so it will be forced through a nozzle in the side or bottom. Some have a piston arrangement which works like a grease gun. One model uses a lift pump to fill the die cavity at low pressure, after which a secondary, low-volume, high-pressure piston rams the die and packs the wax.

When several machines are in use, it often pays to have only one wax pot common to all for easier control.

WAXES

WAXES are compounded from many sources, and every caster seems to have his own private concoction, some of which are for sale. (Wax is supposed to defy chemical analysis.)

One wax (not necessarily typical) used for gas-turbine blade patterns has the following formula:

	%
Blue Industrial Wax	43.5
Paraffin	21.5
Cerese Wax	21.5
Carnauba Wax	13.5

New waxes are under development

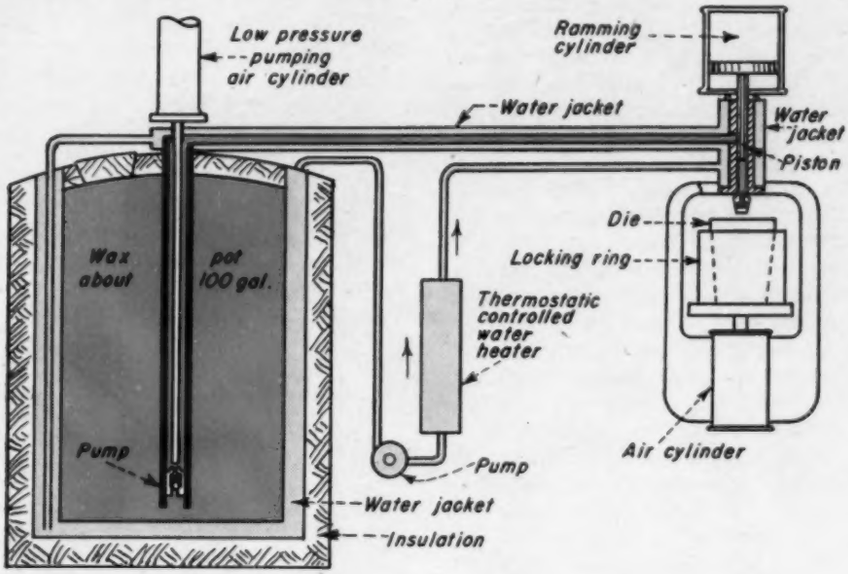
and every conceivable composition is experimented with. Polystyrene and other thermoplastics have been tried either "straight" or as components in wax with little success thus far. In addition to the problem of making a non-shrinking, non-warping and fairly safe-to-handle wax, plenty of consideration must be given to the effect on the investment. Waxes tend to penetrate the porous mold surface, necessitating an oven temperature of at least 800 F to remove the final traces. These wax remnants do not necessarily attack the mold chemically or mar its surface, but they clog the pores and cause bad gassing when the metal is poured. The high oven temperature is undesirable from two standpoints. It costs a lot to operate and it means going to an expensive vitreous-type investment because the clay-bonded earths break down above 425 F. For these reasons, considerable work has been done on non-penetrating patterns, like low melting-point (and low freezing-point) metals. Here, dross, (oxide scum) is the big problem.

Some pattern waxes, excellent from most standpoints, attack the investment chemically. Many of these problems now seem very close to solution.

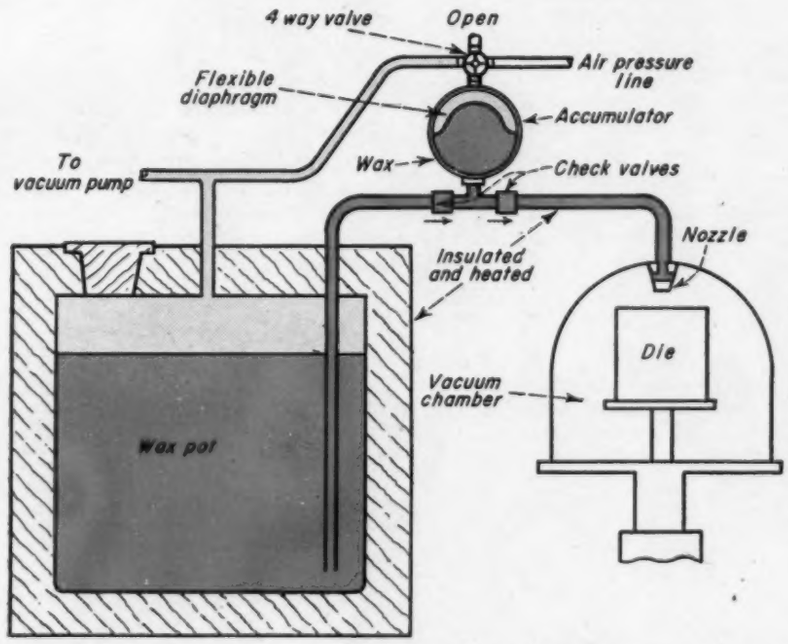
Parting lubricants are required both in making the patterns and in investing them. Dies are sprayed or brushed with a thin oily alcohol-like material, and this is repeated before the investment is poured.

One important factor in selecting the right pattern material (and the entailed equipment) is the size and intricacy of the parts, and the production anticipated. Small flat parts lend themselves readily to plastic-injection methods, and probably to use of styrene instead of wax. This permits hobbed dies and multi-cavity dies, which can be produced by mounting several die blocks in one frame.

Large parts can often be subdivided into convenient smaller units for wax molding, reducing die cost and danger of shrinkage.



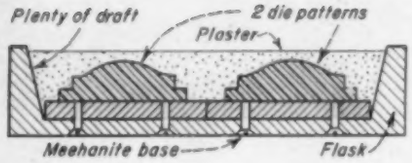
COMPOUND-PRESSURE INJECTION uses a lift pump to transfer wax from the large pot into the die cavity and a small high-pressure piston to close off the transfer passage and ram the pattern. Large wax pots like this are easier to heat and control with water jackets and insulation and can serve several machines

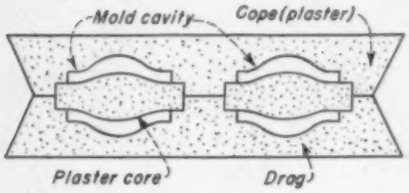


HYDRAULIC ACCUMULATORS instead of lift pumps can inject wax in a high vacuum. Evacuated dies reduce bubbles but entrained air still can weaken and distort patterns unless removed

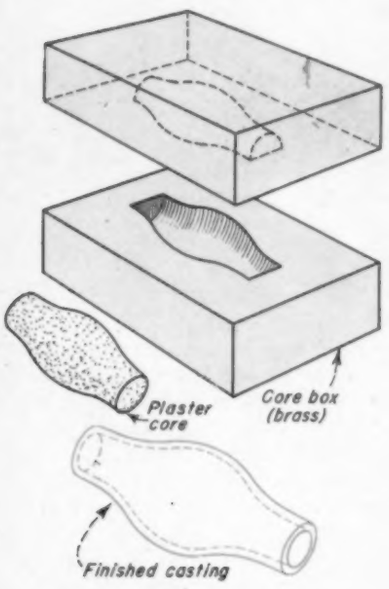
DIE PATTERNS can be fitted into the standard flask in various size units up to about 20 patterns. One half-pattern shapes the cope cavity; its mate molds the drag in exact register

FLASK ARRANGEMENT is thus flexible, and substitutions are easy. Unused sections can be filled with blanks

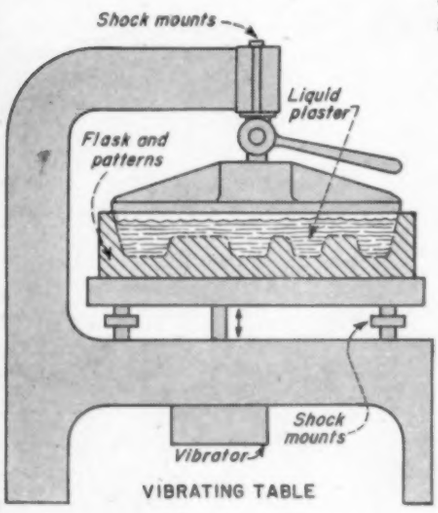




BRASS PATTERNS and runners are screwed to the baseplate of a standard-size cast-aluminum flask



LOOSE CORES are made in brass core boxes from the same plaster mix and oven-baked for assembly into their molds before casting the metal



VIBRATING TABLE

Cope and Drag Patterns

PLASTER'S soupy consistency precludes use of standard sand molding techniques because the mixture is very fluid and won't support the patterns.

Instead of trying to mold a solid pattern first in one flask (the drag) to the halfway mark (parting line), then covering with another flask (the cope) and filling the remainder of the mold, the pattern is itself split in half, and each half is fastened to the bottom plate of its water-tight flask, either the cope or the drag. These two bottom surfaces are ground to a high degree of flatness so the ensuing molds will fit together in proper relationship as though they had been molded against each other.

Symmetrical parts will be split equally in half and the cope and drag with the semi-permanent die-patterns will be mirror-identical.

Box-like parts will fall almost entirely within the cope or the drag, and the patterns will consist of a form for the outside of the box which projects above the match plate and a depression in the other match plate equivalent to the inside of the box. Complicated shapes make use of parting lines in different planes and curved parting lines, and removable metal inserts. Deep cavities can use collapsing metal cores, but the point is quickly reached at which plaster cores are preferable from every angle.

Patterns are made from a low-cost machineable alloy with enough hardness to resist ordinary handling. Brass is the usual material.

Flasks are made of cast aluminum and provided with generous draft to simplify extraction.

With or without the match plates, plaster can be poured in any container; a shoe box will do, because nothing about the outside of the mold is at all critical. But the plaster-mold process has been developed specifically for high production and one standard flask has been selected which produces a 3½ x 11½ x 17½-in. mold (both halves). The pattern and match-plate combination, called a die-pattern, may fill the flask, or several of these unit strips up to about 20 can be fitted. Sometimes a unit strip will carry several permanently mounted die-patterns when they all belong with the same job. This kind of flexibility permits quick changing of the flask layout at any time, either wholly or in part, and when a part is to be removed but no substitution made, the space is filled with a solid blank. Standard runners in many sizes are carried to gate the flask; the proper cross-sectional area is calculated by the formula, 0.0007 sq. in. per oz. metal in the cavity.

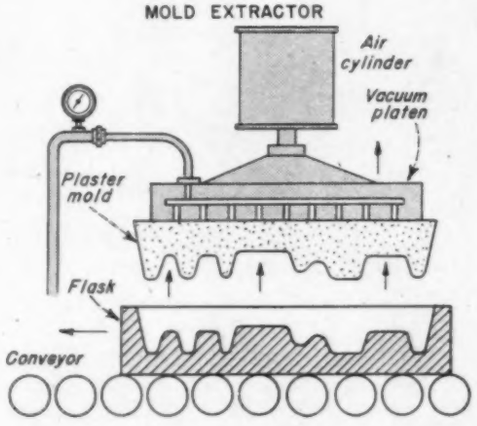
Symmetrically-parted pieces up to 3 in. deep can be cast and small studs or projections may extend this slightly as long as the plaster coverage is deep enough for strength. When the parting line is off center, the maximum depth in one side is limited to 2 in.

Flask layout is such that some runners are fastened in the drag and the rest fastened at 90° away in the cope. This eliminates tee and cross connections and complicated special construction. Register pins in the two flasks assure good mold alignment.

After extracting the molds, they can be picked up and turned over by hand and put on the conveyor to the oven, or as in most shops, a special turnover unit is provided which takes the mold from the extractor and puts it right side up on the conveyor.

FILLED FLASKS are agitated for about 1 min. to release air bubbles and to assure complete coverage and good mold surface

MOLD EXTRACTOR



EXTRACTOR lifts mold after it returns from the setting table. Flask goes back to the molder and mold goes to oven

Making the Mold

FOUNDRIES have long dreamed of something better than sand into which to pour metal. Precision casting has evolved as a result of two general developments in this direction, but drawbacks are still numerous and the perfect answer has yet to be found.

The basic idea of a very smooth, strong surface that will withstand high temperatures is easy enough to attain in many ways, but it also must be reasonably priced, easy to remove after casting, chemically inert with metal and waxes to assure clean parting, have minimum shrink or swell during setting and curing, and be porous or permeable to gases which must escape through the mold during pouring, and not too difficult to work with.

With so many different alloys in use, it is natural that no one investment material or combination suits them all. Fortunately, most casters specialize on one or two groups of alloys near enough alike within groups that a standard procedure can be followed.

Non-ferrous castings can be made in plaster or silica-type molds. But both of these, like the waxes, are specially compounded with other ingredients to improve the mixture. Ferrous, or higher temperature, alloys require a different investment, usually silica gel or tetra-ethyl silicate or magnesium ammonium phosphate, but because of high cost, this is applied to the pattern as a thin coat by dipping or spraying, and then backed by a cheaper mixture of fine sand, water, alcohol and some kind of binder.

One manufacturer sells a ferrous investment material called Ferrolite which does not require the customary dip or spray coat.

Plaster has been eyed hopefully for a long time, and finally the many drawbacks have been whittled down to the point where it can be used with excellent results commercially. Various other ingredients have been mixed with the plaster and all sorts of water ratios (at various temperatures) have been tried in order to improve the air permeability and to cut down baking time and reduce the tendency to thermal distortion or cracking while at the same time preserving its ability to "give" under physical pressure. It is now being used as an investment for any and all copper-base alloys as well as aluminum and magnesium, the only limitation being a maximum lead content of 1.75%.

Capaco's investment composition is:

Parts by volume
- 79 $CaSO_4.\frac{1}{2}H_2O$ (calcined plaster)
- 20 $H_2Mg_3(SiO_3)_4$ (fibrous talc)
- 1 terra alba (accelerator)

180 water

Weight ratio: 6.3 lb. dry plaster mix to 11.6 lb. water.

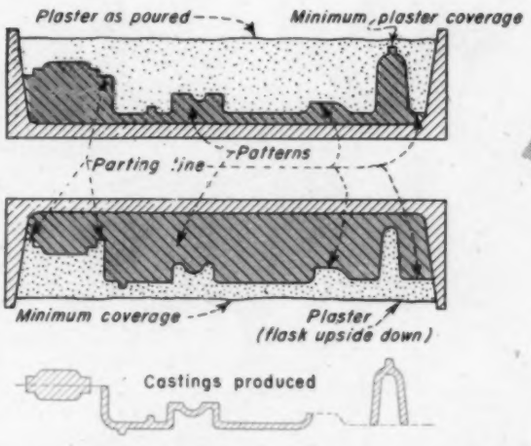
To assure a smooth, creamy blend, the dry components must be sifted or "fluffed" continuously into the mixer and the water must be sprayed in. Proportioning the ingredients is a continuous rather than an intermittent process and the "soup" must be used immediately before it sets.

The present mixture and technique has a cold-setting time of about 8 min. (after which it is safe for extraction) and can be baked, ready for casting in 1½ hours (a huge improvement over the 1-hr. setting time and 24-hr. baking time once thought to be the commercially practical minimum).

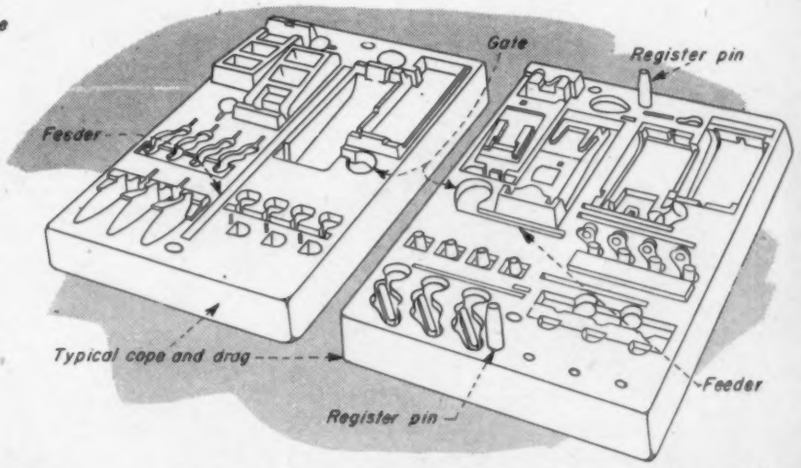
There are so many kinds of silica-type investments that general information would be meaningless. Some of the earlier ones used to produce the first gas-turbine equipment required a curing time of 144 hr. because the material cracked if heated or cooled too rapidly. (All of these are good heat insulators, of course). Now, curing time is 2 to 6 hr., depending on the size of the flask and the material and the metal to be cast.

Oven exit temperature varies widely with the material used; the chief determining factor is the shape of the thermal expansion curve which is never linear, and not because of anything to do with the molten metal. Every investment contracts and/or expands as the temperature is increased at different rates at different temperatures, and because it is difficult to maintain the oven exit temperature or to control or estimate the rate of cooling, it is best to bring the mold out at a temperature at which it is expanding or contracting slowly so the dimensional variation will be at a minimum.

Wax removal is one of the chief reasons for the high temperatures and special materials required to



PARTING LINES in several planes permit deep parts to fall entirely within one mold half and simplify pattern removal on complicated pieces



SPRUES AND RUNNERS are longitudinal and transverse brass strips. Drag, left, has main runner and some short runners. Cope has gate and transverse feeders

produce satisfactory monolithic molds, and while plaster can be cured at low temperature (to remove all traces of water which would later turn into steam) it takes a lot longer, and time is more costly than a high-temperature oven.

High-production automaticity on diversified products, the ideal of most foundries, necessitates many compromises in molding technique. But if only one part is to be made in large quantity, and a complete setup is established for it, there is no reason why many obvious improvements shouldn't be made.

Two-part molds, for instance, can be further subdivided indefinitely for easier and *more accurate* molding on complicated parts by using the "seal-edge" system which interlocks any number of mold elements and completely prevents flash or distortion. Further, slab molding, where one or more patterns are molded in a uniform rectangular or cylindrical flask with no regard to anything but minimum mold thickness introduces unnecessary casting variables. For high production, a contoured flask can be used so the resulting mold will have uniform shell thickness and heat dissipation and gas permeability will begin to be controllable.

There is still a lot of room for improvement in this department, and the field is so unlimited that you can start practically anywhere.

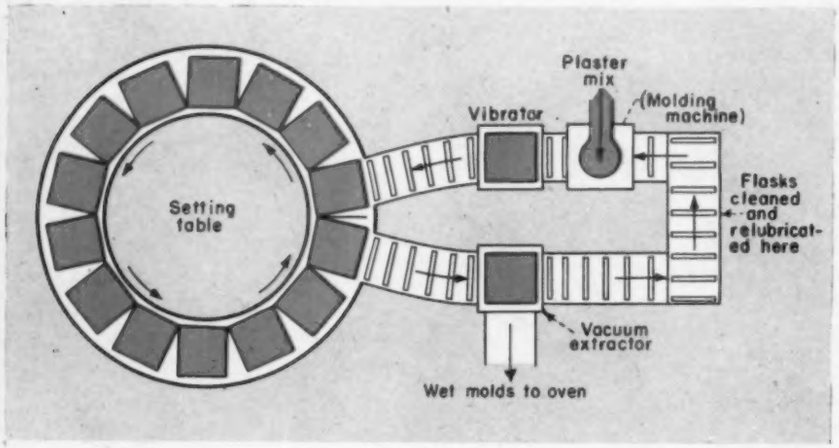
What are now exclusively lost-wax investments could be used with the cope and drag method, and plaster might be used in conjunction with some type of non-fouling expendable pattern. The larger practical size of cope-and-drag-made castings might be combined with wax appendages to reproduce small details, as in the making of one-piece supercharger or turbine rotors, complete with blades.

Keeping these two fields separate is something like having a lathe department and a milling-machine department completely separate, and having them both trying to compete on the same work. That's a little far-fetched, of course, because many of these details have been worked into a continuous production process where random changes would be foolish, but there is nothing to prevent a new process from developing which will borrow ideas from both.

In addition to all the other gains, baked ceramic molds, with their high specific heats, open up hitherto impossible casting fields. Aluminum poured into a metal or metal-chilled mold will cool rapidly, which is desirable, but the chill will also heat rapidy and the rate of cooling will diminish too soon. A silica mold, prefrozen at –50 F will absorb the heat of the molten metal rapidly, but will not rise in temperature enough to decrease the cooling rate. Controlled cooling can further be improved by circulating some liquid through pipes in the mold if desired.

These factors permit the casting of aluminum alloys with as-cast tensile strength fully twice that possible by any other metalworking method.

Stainless steel is a very difficult alloy to cast in sand because the rapid cooling will chill and distort or crack the casting. A silica mold at 2000 F slows the cooling rate enough to keep the metal fluid and permit it to flow into the tiniest corners and holes.



MOLDING CIRCUIT keeps about 20 flasks (10 complete molds) in steady rotation, requires two men, and produces one mold a minute. This allows 14 min. for setting and 6 for extracting, cleaning and lubricating, molding and vibrating. Cycle can be considerably speeded if necessary

Lost Wax Flasks

HARDENED CERAMICS are usually strong enough or can be made strong enough to require no flask at all during baking and casting, and some casters use flasks for molding only. But a permanent flask protects the mold against abuse and makes it safe for use in centrifugal and other pressure casting machines. Flasks for lost-wax casting need only encase the mold until it sets, so they are usually just a thin metal tube of any shape, big enough to enclose the patterns with sufficient investment wall. When special casting machines are used, the flasks, of course, shape the mold exterior to fit the machine. When the flasks have to pass through hot ovens where corrosive gases, such as burning wax and alcohol are present, special alloys like Hastelloy are required, or flasks will disintegrate rapidly.

It is best to standardize on one flask size to simplify casting, even when special casting machines aren't used. When small castings are being run, the flask should be filled as completely as possible, of course, so patterns are assembled into clusters on a common sprue. When this is standard procedure, the sprues and runners are carefully designed and molded in wax in the same way as the patterns themselves, and the patterns may even have special holes to match and fit the runners to speed assembly. Patterns should undergo the very minimum of handling because they are fragile at best, and warm, moist hands will easily distort or mar the surface.

The pattern and sprue assembly is placed upright on a plate or rubber disk and then encased by the flask tube and sealed around the bottom to prevent investment leaks. When special casting machines are used, and the gate must match the spout on the furnace or crucible, a rubber or metal former is sometimes used, or the shape can be obtained by molding the gate in wax.

The wet investment mix is full of air and excess water and the volume decreases greatly during setting. For this reason, flasks are temporarily extended to hold additional mixture. The actual setting, before dewaxing and baking, has problems, too. Precoated patterns are safe from air bubbles, but the rest are not, so flasks are encased in a bell jar and held under a partial vacuum and vibrated to dislodge and expel en-

trained air, and air in solution, which would be liberated when the water evaporates. Vacuuming should be a gradual procedure. A sudden pressure drop from atmospheric to about 1 in. of mercury will cause practically instantaneous boiling of the water, and the air will fairly burst out of solution, with possibility of internal damage to the mold and almost certain splashing and spattering of investment. The vacuum should be built up by degrees, allowing the air to be drawn off slowly instead of violently, until the highest possible vacuum is reached. Final traces of air require the high vacuum to break them loose from the sticky investment.

Ferrous investments, because of the dip coat, are not deaerated, but they have to be constantly vibrated from 1 to 24 hr. until set, in which time the fines (as well as excess air) come to the top and the body of the mold becomes quite coarse and porous.

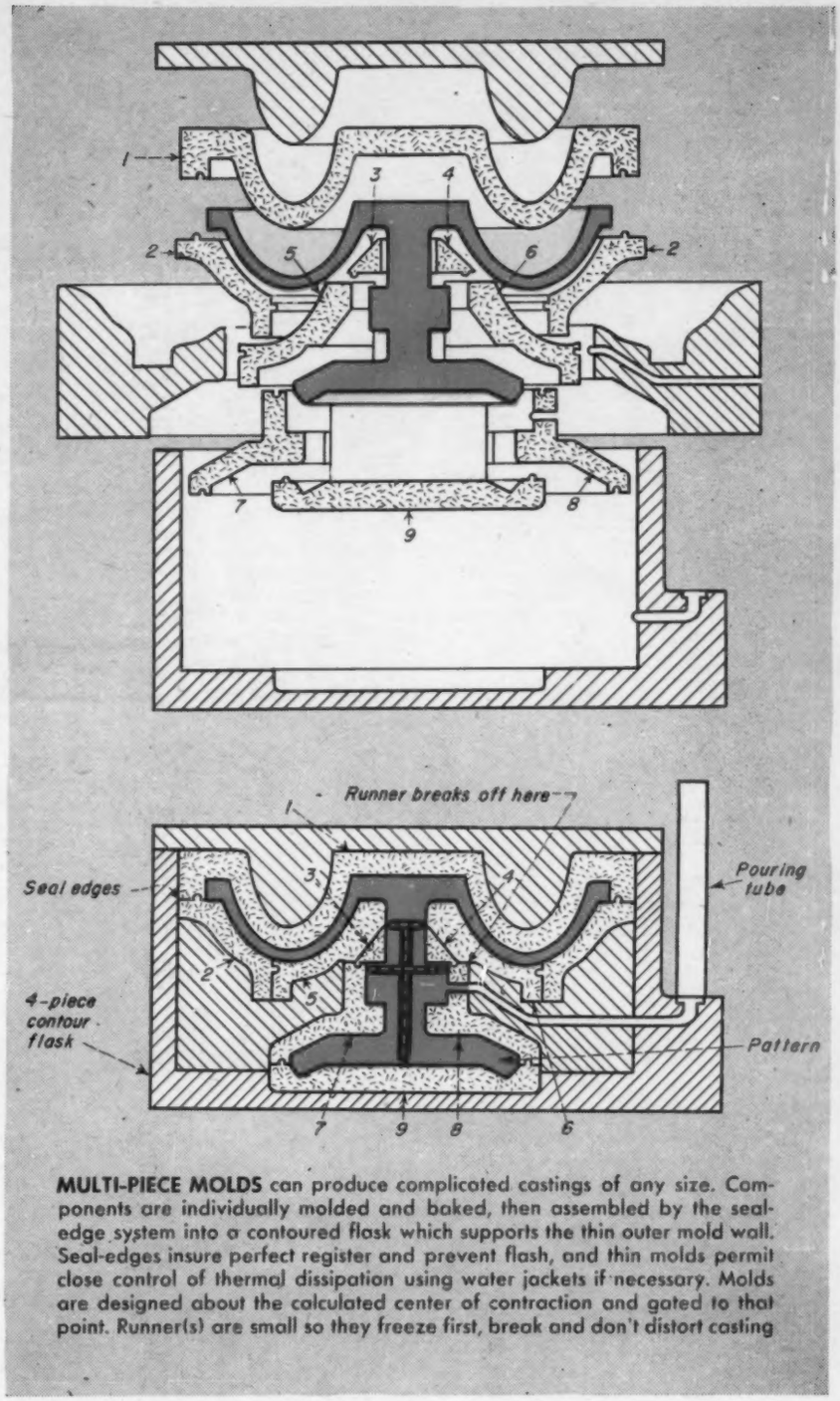
Drying the dip coat can be hastened considerably by passing the dipped pattern clusters through a small warm air circulating tunnel. This cuts the drying time from an hour or more down to a few minutes.

OVENS

A LOT OF MONEY has been lost by hasty decisions on ovens. Ovens are very much a necessity and conveyor ovens seem the obvious road to smooth production. But requirements must be carefully analyzed with relation to the whole process before sinking $40,000 or so into an oven which may prove unsuitable.

A good oven for the lost-wax process can be composed of two sections, one, a low-temperature chamber to melt out as much wax as possible for reclamation, and the other to bake the mold (and burn out all residue). A long chamber just large enough to pass the flasks is good because it permits a controlled temperature gradient and a minimum of heat loss and close control of the exit temperature.

Plaster molds are tricky because of their high affinity for water. The condition and even the chemical composition varies continuously with temperature changes, so rigid control must be maintained for uniform results. Best procedure is to heat plaster quickly to 1450 F for 20 min., then cool and recalcine at 450-500 for 1 1/3 hours.

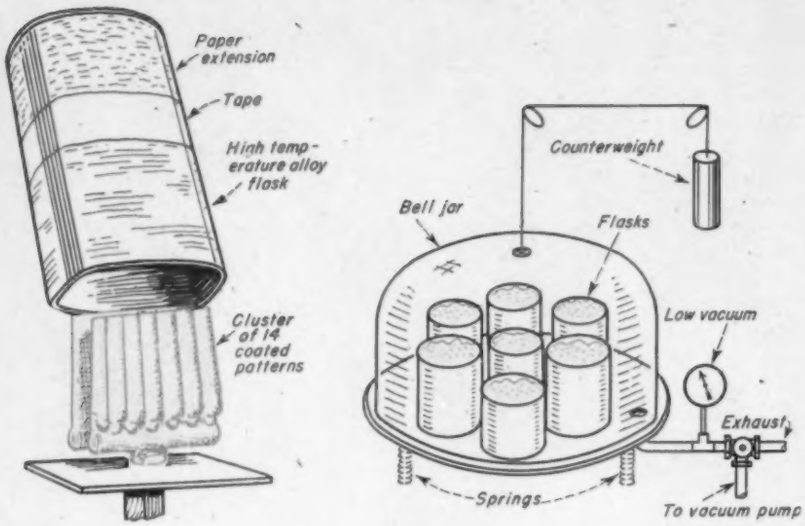


MULTI-PIECE MOLDS can produce complicated castings of any size. Components are individually molded and baked, then assembled by the seal-edge system into a contoured flask which supports the thin outer mold wall. Seal-edges insure perfect register and prevent flash, and thin molds permit close control of thermal dissipation using water jackets if necessary. Molds are designed about the calculated center of contraction and gated to that point. Runner(s) are small so they freeze first, break and don't distort casting

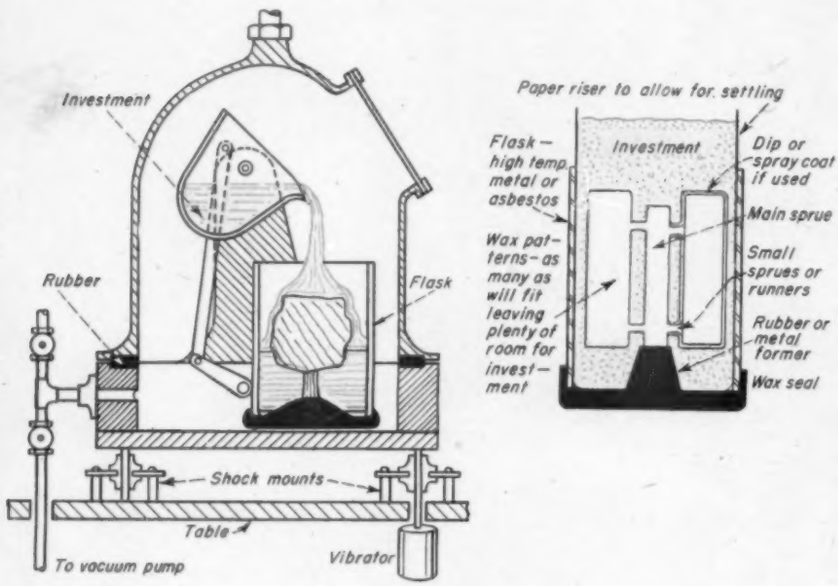
Melting Equipment

INDUCTION and arc furnaces share about equally in the metal melting. Both types are fast, clean and efficient. Sometimes metal is melted in a large furnace and kept hot and transferred to small ladles or crucibles in exact amounts for pouring as needed. Sometimes alloys are prepared in large furnaces under close metallurgical control, then cast into small pigs of uniform weight for remelting later. Just as often, pea-size pellets of pure metals are stored in ready-bins and weighed out directly into small crucibles so alloying, melting and casting is done without transferral.

One manufacturer of precision-casting equipment makes a melting table which contains induction coils and a large variable-inductance coupling. Ceramic crucibles of several standard sizes can be inserted and adjustments made for most efficient heating, and when the pyrometer shows the correct tem-



SPRAY OR DIP COATS economize on costly investment required for high-temperature casting. Here, flask is about to encase a dipped pattern cluster to hold the cheaper backing investment. Non-ferrous casting uses one homogeneous investment which has to be deaerated to prevent surface defects



VACUUMING is done in a bell jar. Some use a large plastic jar which holds several filled flasks; for better results, flasks can be filled in a partial vacuum, removing air from the investment before pouring. Low vacuum is adequate and high vacuum causes ebullition and spattering

perature, the whole crucible is transferred with tongs to a centrifugal-casting machine which slings crucible and flask as a single unit.

The rocking arc furnace seems very suitable for melting and alloying fairly large melts quickly because the ingredients are tossed and tumbled, assuring even heating and blending.

Much of the melting equipment (and casting machinery) in present use is too small for economical production. Most of the furnaces are capable of melting only a few pounds of metal at a time, and seldom is any attempt at continuous melting made.

Long runs on one part or several parts using the same alloy could and should profit by the opportunity to melt the metal in larger crucibles. Two or three furnaces in proper phase then could supply a continuous flow of molten metal. One would always be pouring, one would be just coming up to temperature and one would be charging, thereby effecting time and labor savings in operation and maintenance.

Pouring

DENSE METAL STRUCTURE, freedom from inclusions and smooth surface are necessary fundamentals of precision casting and to obtain these qualities every conceivable expedient has been tried. In principle, the two basic requirements are pressure and a minimum of contact with air (molten metal oxidizes rapidly).

Pressure can be obtained in any of three simple ways and often, more than one is used at the same time. It has been found that high pressure gains nothing and is likely to damage molds; something between 3 and 15 lb. gives best results. To eliminate air, the metal can be melted and poured in a vacuum, or the mold alone can be evacuated through its porous surface during casting while the crucible-furnace is kept covered as much as possible, or the sprue can be inserted down into the crucible and the metal drawn upward into the mold by a vacuum, or the mold and crucible can be clamped together and sealed for pouring.

A long riser is the simplest way to obtain pressure. In the plaster-mold process, an asbestos tube is inserted in the gate of each flask and the 8- or 9-in. head puts a pressure of 3 or 4 psi. on the mold. About the same effect is achieved by placing the flasks on a vacuum table; the strong suction through the investment tends to pull the metal tightly into the cavity and to aid materially in venting any gases. Sometimes air pressure is applied at the gate or at the bottom of the upturned empty crucible immediately after pouring. Centrifugal casting machines sling the whole flask or several flasks or revolve large, symmetrical molds about their central axes, causing metal to flow rapidly to the extremities of the cavity.

Finishing

AFTER THE MOLDS have cooled sufficiently, the castings are removed by knocking them out with a hammer, the force used depending on the metal and delicacy of the casting, of course. Air, water and steam blasts are sometimes used to aid in removing final traces of investment, particularly in interiors. Sand may be added to the blast if it doesn't damage the surface of the casting. Sometimes the spruing can be arranged so the metal will break off

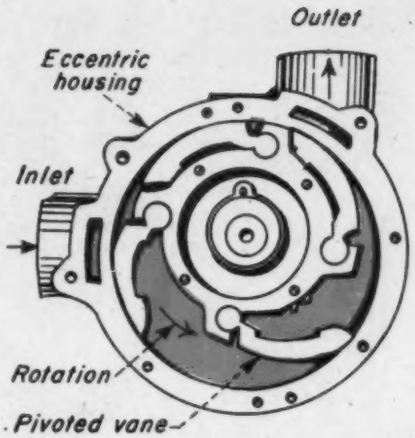
inside the mold by shrinkage alone; usually sprues and runners have to be cut off on a bandsaw for soft metal or a rubber-bonded high-speed abrasive wheel for very hard metals. This, followed by a little touch-up on a grinder close to the runner juncture, and clean-up of the few minor imperfections which are inevitable and ordinarily not sufficient cause for rejection, usually completes the caster's job.

Perhaps the quckest and most reliable way to judge a precision casting shop is to look at its finishing department. All mistakes from the very inception of the design through all the rest of the production stages culminate here, and more than any other single factor, finishing costs can make or break the outfit.

Some shops have grinding departments capable of machining all castings all over. Others have none at all, save for cutting-off; they scrap everything that's not perfect. The happy medium is, of course, the best, but this final stage in the process is so completely dependent upon everything that precedes it that it will almost take care of itself if the rest has been planned intelligently.

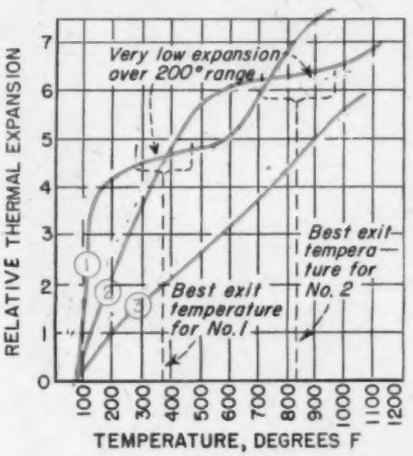
Design

SHAPES AND CONTOURS of almost unlimited intricacy (which would require an assembly of many machined parts) and metals which cannot otherwise be worked are precision casting's talking points. High accuracy has been oversold, BUT good surface finish and dimensional accuracy are usually possible for all but "precision" mating machine parts, and here, only a final machine-grind is necessary. Absolute freedom from surface imperfections without a high rejection rate is usually difficult, and some agreement should be made about what is an acceptable flaw and what is inacceptable.



VACUUM PUMPS of this type are suitable for a main supplying several bell jars and/or vacuum casting machines

Casting shapes metal in an entirely different way than any other metalworking process and it is necessary to understand the fundamentals


RELATIVE THERMAL EXPANSION
Very low expansion over 200° range
Best exit tempera— ture for No. 2
Best exit temperature for No. 1
TEMPERATURE, DEGREES F

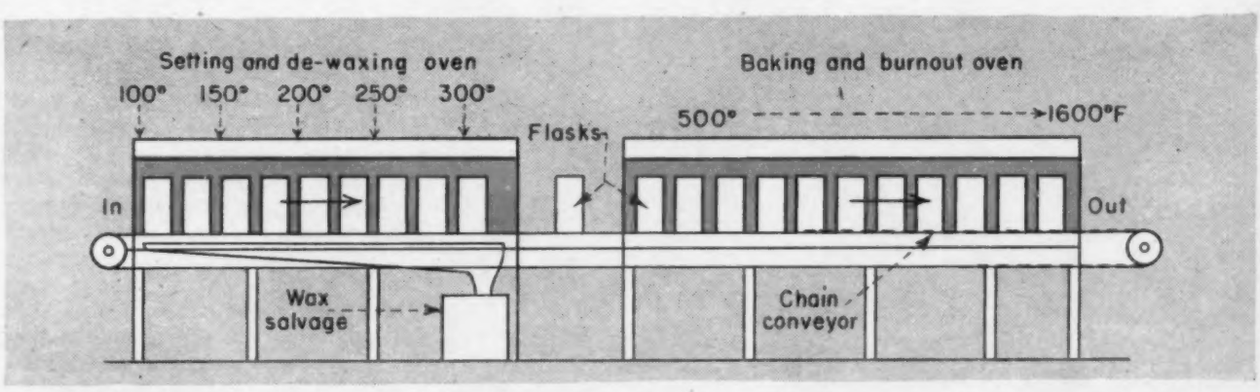
THERMAL CHARACTERISTICS of investments vary widely. For closest control it is best to bring molds out of the oven at a temperature at which specific mold shrinkage will be low. No. 3 is a poor material

of foundry practice before designing parts for casting. The thought to be kept uppermost in mind is that a somewhat viscous liquid metal must flow quickly into a cavity where it will cool and shrink into the desired solid form. This means round corners and edges wherever possible, no more metal than necessary, and as uniform thickness or transition from thick to thin as possible. When these conditions can't be met, the problem can probably be circumvented by special spruing and arrangement in the mold for the best metal flow.

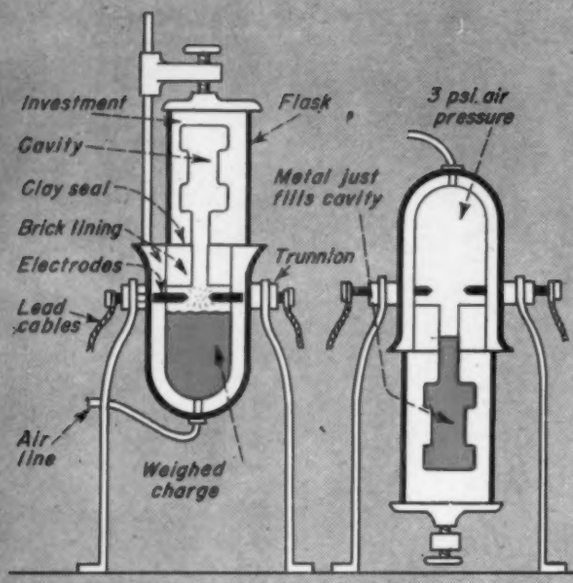
It's a mistake to think that lost-wax castings, because they use a one-piece mold, have no parting-line inaccuracies. Some wax-injection dies have so many components that parting lines may be in three or four different, non-parallel planes, and the finished mold will be shaped by the wax pattern and will therefore incorporate any inaccuracy incurred there. Good dies are the best guarantee for accurate casting, but it is always better to plan critical dimensions for a solid part of the die or die-pattern in cope and drag molding.

Draft (tapered sides) always eases the removal of a casting—whether it's a wax pattern, the plaster mold, or the metal itself (as in die casting and permanent-mold casting). But this is a recommendation, not a necessity. Parallel sides can be cast at slightly added complexity, and ½° draft will be sufficient if the work is done carefully.

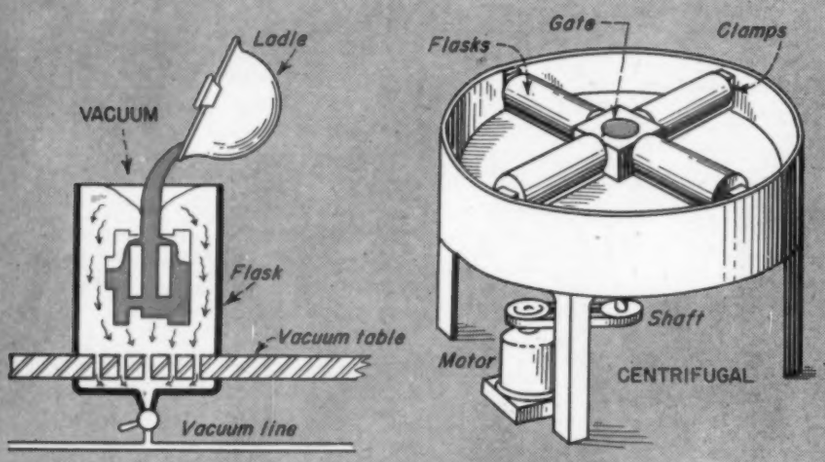
While the subject of tolerances has been highly overworked, surface smoothness, trueness and flatness has received very little attention from a quantitative standpoint. Whenever a process has wide temperature variations there are bound to be large expansions and shrinkages, and when several different



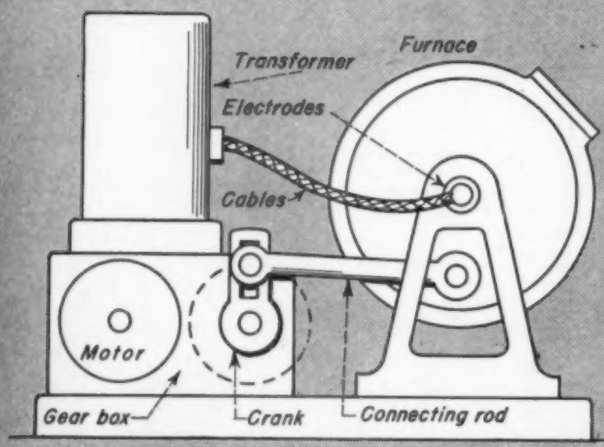
CONVEYOR OVENS of small cross section permit close temperature control and smoothly graduated heating to prevent distortion or cracking and minimum loss at entrance and exit. Some have provision for wax salvage



PRESSURE FURNACES clamp and seal the flask on top, invert to fill the mold, and ram with low-pressure air. The charge is pre-weighed to fill a mold still in the oven and melting is timed so the metal will not oxidize due to overlong contact with air, and flask won't cool off excessively and invalidate shrinkage calculations



VACUUM OR CENTRIFUGAL setups also produce dense castings. Vacuum table draws air and gasses through the porous mold. Centrifugal machines sling one or many flasks at a time. One machine holds flask and crucible as a single unit; others spin large molds about a central axis



ROCKING FURNACES are good for melting and preparing 50 to 100 lb. of alloy at a time. Thus prepared, metal is cast into small pigs for later casting machine use. Induction furnaces of all sizes are also common and these have the advantage of removable crucibles

materials are trying to work together, with temperature gradients across each material to boot, the estimation or calculation of precise dimensions becomes extremely difficult, if not impossible. Large, flat surfaces are particularly vulnerable to this kind of unpredictable variation.

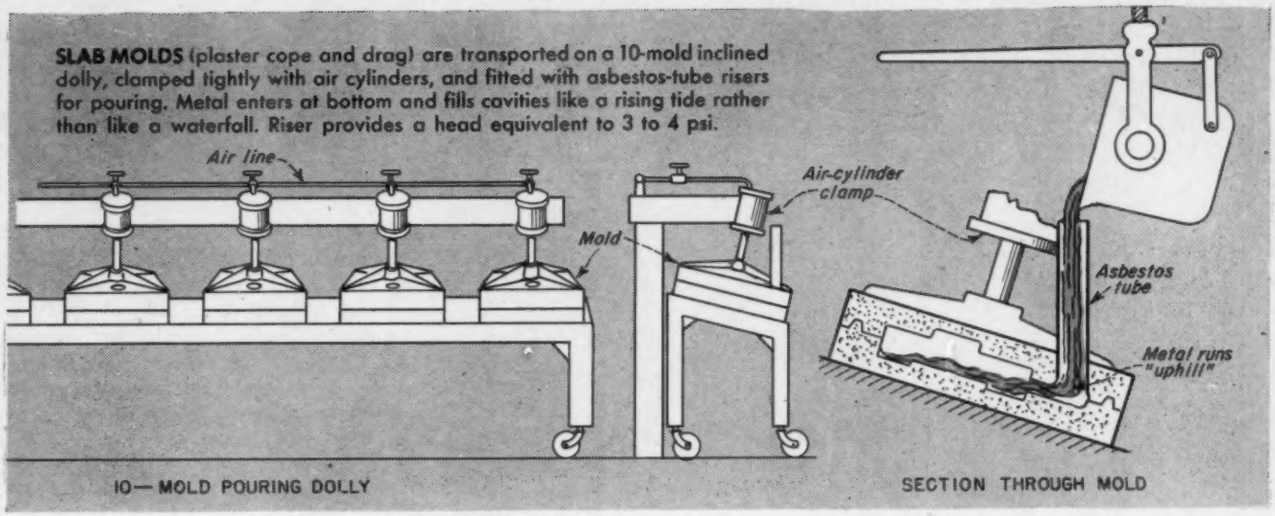
Most metal shrinks around 2% on solidification, but every metal is different, and if the metal cools at different rates in the mold, the shrinkage will occur in different places and the casting will probably be distorted. 2% is equivalent to 0.02 in. per in., so the difficulty of estimating within 0.002 in. per in. can be appreciated, especially when there is wax and investment shrinkage to worry about too.

There are several widely used methods of minimizing and controlling the location of shrinkage. When wax patterns must have thick sections, a wax chill can be molded in advance which will slip into the final die and nearly fill the heavy section, leaving a wall about the same as the other thin sections. Far less wax is now required to fill the die and cooling will be uniform because of the uniform wall sections. This will cure wax shrinkage difficulties in most instances.

The arrangement of patterns in the flask will govern the metal shrinkage to a large extent, too, and sometimes wax shrink bobs are added to the patterns to hold a relatively large mass of metal which will cool slower than the desired piece and therefore cause most of the shrinkage to take place in the bob instead of the part. Following this idea, a heavy part of the casting itself can be made oversize deliberately so the thinner areas can draw from it and enough stock will be left on a simple-to-machine region to finish the casting easily with a broaching or milling operation.

Surface smoothness depends on the degree of polish in the dies, the hardness of the wax, the kind and condition of the wax, the alloy being cast and to a considerable extent upon chemical action between these different materials, especially at elevated temperatures. But for average results the cast metal surface is smooth enough so a high polish can be imparted with rouge-type abrasives and buffing.

Maximum size of castings is limited by the strength of the investment material and its ability to hold a large volume of metal under pressure. Fairly large castings have



SLAB MOLDS (plaster cope and drag) are transported on a 10-mold inclined dolly, clamped tightly with air cylinders, and fitted with asbestos-tube risers for pouring. Metal enters at bottom and fills cavities like a rising tide rather than like a waterfall. Riser provides a head equivalent to 3 to 4 psi.

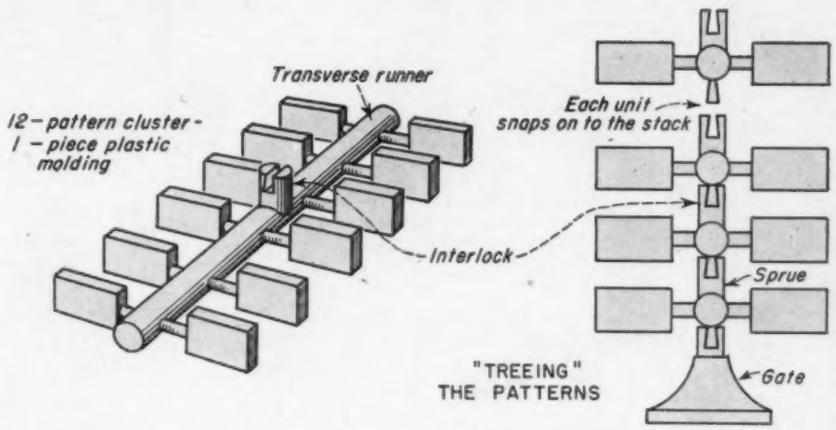
been made on an experimental basis, but the problems are increased to such an extent that little attempt has been made at volume production so far. Such developments are definitely on the way, however.

Precision casting is a complex process and careful analysis and engineering must be applied to each job to work out the best details for production. The only way to keep costs down is to use automatic or steady flow production methods, so some shops will not accept jobs involving less than 10,000 pieces. Die costs are far lower than for die-casting, but this is a small factor in lost-wax or cope-and-drag casting. Small orders can be filled, but an entirely different kind of plant is required, and even though the patterns can be of the most makeshift sort, the job will be proportionally as expensive as skilled toolmaking is to automatic machining.

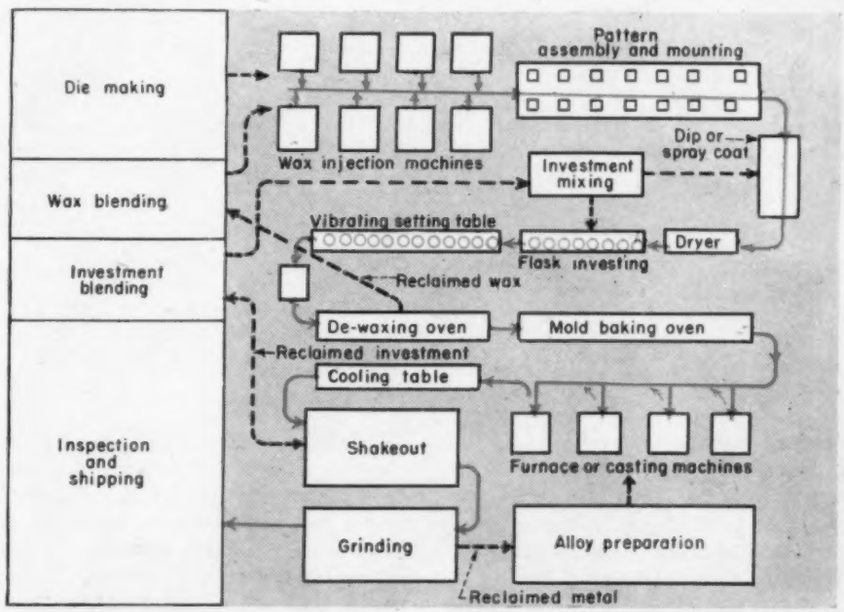
The objective of the new field of precision casting is the development of engineered techniques to suit any set of requirements which will minimize experimentation and cut-and-try costs and establish procedures which will permit immediate introduction of new items into the production line without necessity for trial runs.

The precision castings designer, armed with complete facts, should be able to visualize in advance every production step required, and only in this way can true economy be reached. Everything hinges around the critical period of actual pouring, and all the steps in mold preparation should be worked out in reverse from that starting point.

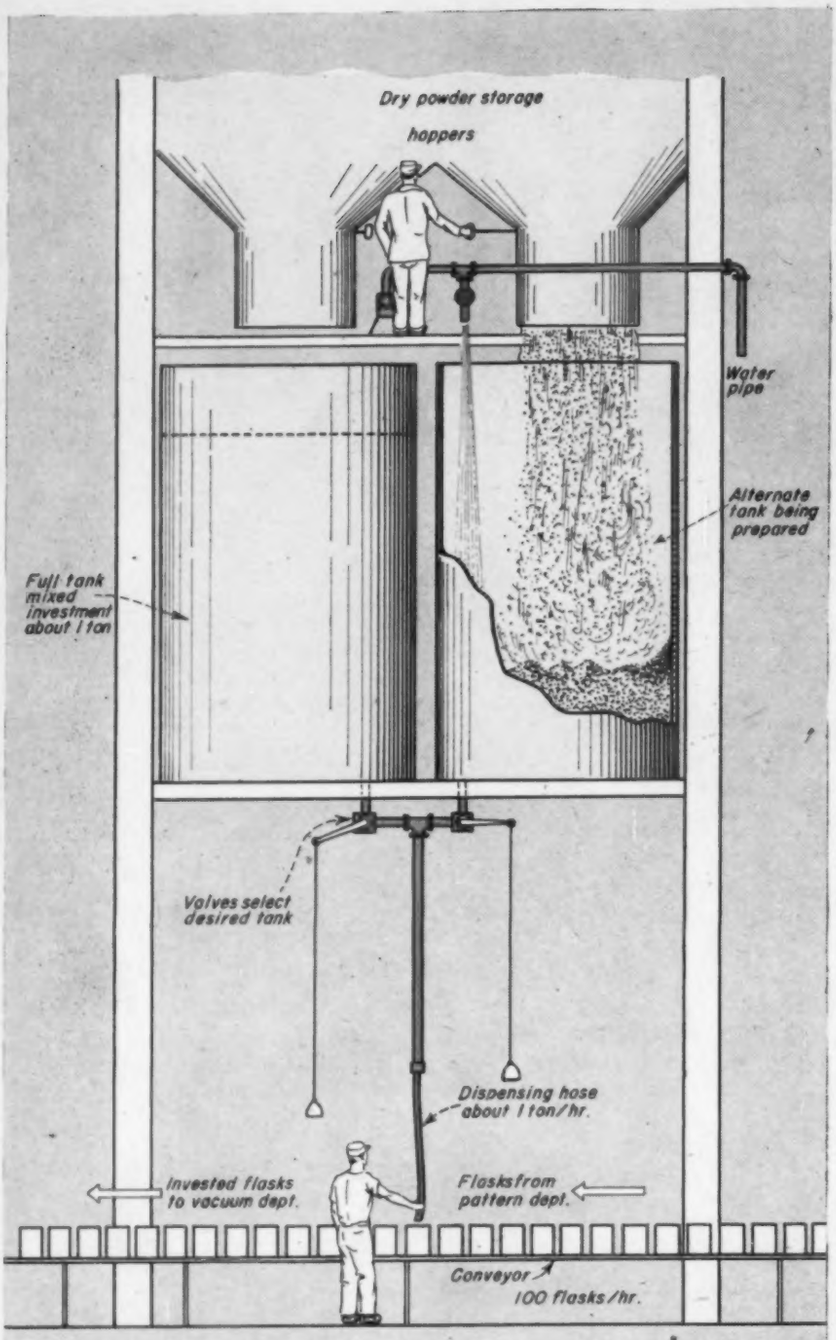
Mold gating has long been a secret art simply because accurate knowl-



STYRENE PATTERNS (instead of wax) are injected as many as 20 at a time and the cluster is ready for investing as molded. Unit clusters have snap interlocks facilitating large trees without tedious wax "soldering"



PLANT ARRANGEMENT for efficient flow of materials could look something like this. Details will vary widely according to the specific process, differences in equipment, and volume, but smooth flow is very essential



ONLY TWO MEN are required with this setup for investing 100 flasks per hr. representing about 10,000 small castings. Tanks are used alternately providing a continuous supply and the 2-hr. setting time of this low-cost investment permits the use of these large quantities with safety

edge of what actually happens during pouring never existed. The 0.0007 sq.in. runner cross section per oz. of cast metal establishes a standard, at least. This makes a seemingly very small runner, but the theory that a cavity should be filled slowly, at a definite rate, rather than turbulently has been adequately substantiated. This, combined with an awareness of the "center of contraction," leads to casting where the part contracts toward its own center and is not pulled out of shape by a heavy, slow cooling runner. When properly designed, runners freeze just a split second after the cavities are filled and break off without fail within the mold under the tensile stress imposed by the opposed contraction forces in the casting and in the main sprue. Besides making a better casting it is obvious that subsequent finishing has also been reduced.

High Production

10,000 castings would barely complete the experimental run according to the plans and expectations of one company; when full capacity is reached, they expect to pour several tons of precision castings daily.

They treat every job first as a precision plastics injection molding problem where the product is not an individual piece but a cluster of pieces complete with runners and sprues ready for investing. Low-polymer styrene is used and the presses are similar to but capable of higher accuracy than most plastics molding presses.

Machined, multi-cavity fully automatic steel dies make 16 to 20 finished patterns in a few seconds, and every shot has an interlock molded on top and bottom so each can be snapped on to the last, building up a solid stack as high as desired. In this way, one can make better than 1000 patterns an hour (roughly 10 flasks an hour), and more than replace an entire wax department with ten times the labor cost. Multiply this production by ten and this company's average capacity is obtained.

Investment is mixed in a tower, a ton at a time. There are two 1-ton tanks so while one man is making a new batch, another man is investing about 100 flasks. (No dip coat is needed.) Setting takes about 2 hr. so the mixture is safe enough to handle during the required working period. Flasks are evacuated 100 at a time in one large bell jar, and then fed to the oven for baking. Centrifugal casting machines are used which hold as many as 10 flasks at a tmie.

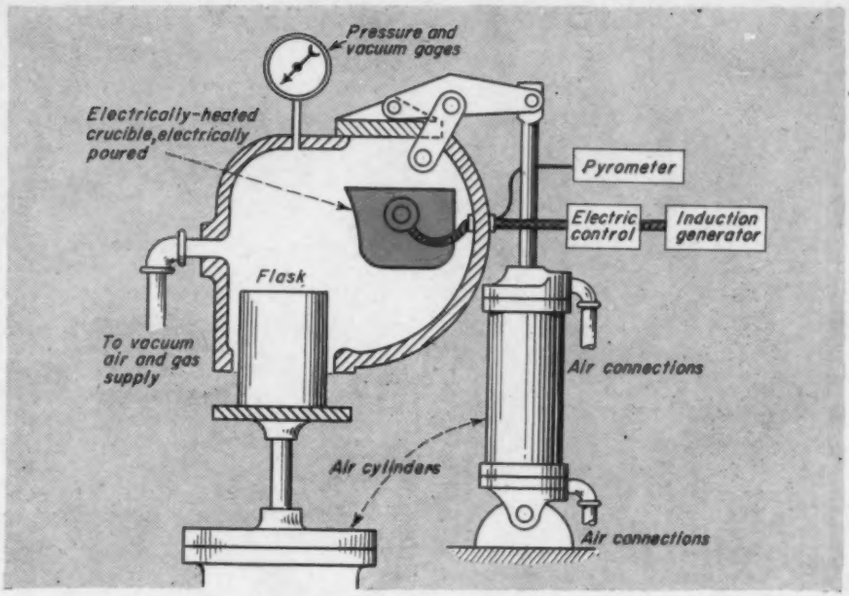
Styrene patterns have proved practical not only for the tiniest mechanism parts, but for the largest castings thus far made by the process, and once this much has been established, other gains follow. These patterns are far more stable than wax patterns around normal room temperature and they can be stored safely for an indefinite period until needed. Handling in the process is safer, too; the hard, elastic surface of the plastic permits any kind of treatment, and tedious hand operations required to assemble wax patterns for investing are eliminated.

The Castings Market

Right now, the best market for these parts seems to be in large production of small items like business machine mechanism parts, inexpensive firearms, some chemical or food process equipment and automobiles.

Gas turbines are still research; no model has been built in any quantity, and even with high unit prices, the volume is too small to run a profitable casting business.

In sharp contrast to precision casting's competitive threat to other methods of fabrication is its application as a valuable time- and money-saving tool in the toolroom and research laboratory. All kinds of plastic molding, forging, and forming dies are costly when made by hand, and usually a lot of experimenting is necessary in developing any new job to get just the right production sequence and the right shape on each set of dies when progressives are used. Somewhat the same holds true of automatic machine tools where cams and templets are involved. Anything from a single pair of gears to a complete experimental internal combustion engine can be precision cast piece by piece in lots of about 50 of each component part. In some cases, the parts thus cast will be finished as is; in most cases they will require finishing, but they will also permit considerable latitude in design, and once experiments on all the 50 pieces have shown the best design, large volume production can be started.



VACUUM AND PRESSURE are used successively in this casting machine. Air cylinders close the steel chamber after the crucible has been filled and the flask is in position; another cylinder tips the crucible when the thermostat indicates that the charge is ready

Experiments of this sort are easy and quick to make and can save hundreds of dollars in toolmaking, and once final designs have been established, these dies can be duplicated in quantity and held for replacement. With this method it is cheaper to throw a damaged die out the window and put in a new one than to try and make repairs.

Precision casting can also be a valuable adjunct to the plastics industry. Methyl methacrylate is sometimes liable to bubbles, and despite all rules of good die design and injection procedure, the trouble may be hard to lick. The comparatively low cost of about twenty semi-finished cast steel plastic molds may be a small investment in the long run. When the difficulty seems to be in the gating, the castings can be finished except for the runners giving the toolmaker the opportunity to gate several identical molds, each in a different way until the answer is found. More complex problems with dies can be solved with a two-stage casting operation where the best of the first batch of "doctored" castings is re-cast in small quantity allowing further refinement.

In the same manner, precision casting can help itself. It will pay on high production jobs to experiment a little with the pattern making setup by casting several preliminary wax injection dies until the best procedure is determined.

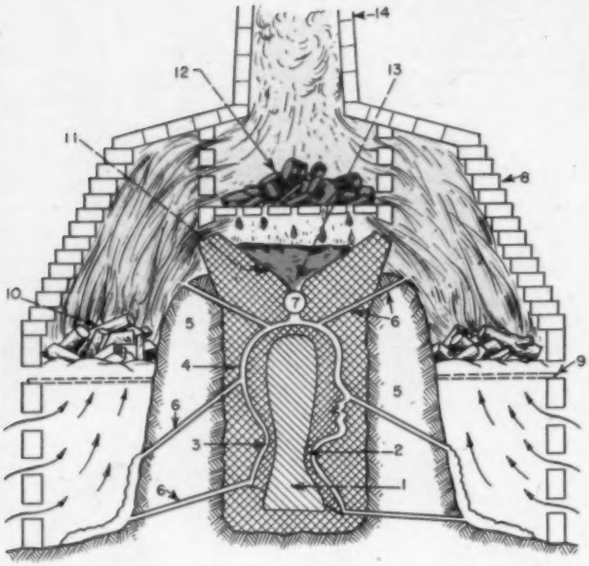
TYPICAL COMPOSITIONS OF PRECISION-CAST ALLOYS

	YELLOW BRASS	RED BRASS	BERYLLIUM COPPER	MANGANESE BRONZE	SILICON BRONZE	ALUMINUM BRONZE	STAINLESS STEEL 304	STAINLESS STEEL 430	STAINLESS STEEL 310	HAYNES STELLITE #21	HASTELLOY "B"	INCONEL
Copper	58-70	R	R	R	R	R						
Zinc	R	5		23	14							
Tin	1	5										
Lead	1.75*	5										
Aluminum				5		11						
Iron			0.5	2.5		5	R	R	R		5	6.5
Manganese				5		1.25			1			
Silicon					5				1.25			
Beryllium			2									
Cobalt			0.5							R		
Nickel							8	0	20		R	R
Chromium							18	13	25	28	15	13
Molybdenum										6	17	
Tungsten											2	

*Maximum for plaster molds.
R=remainder

R=remainder

Florentine Foundry (about 1550)



1—Iron skeleton
2—Clay model ½ in. undersize
3—Wax surface = thickness of casting
4—Clay mold
5—Earth backing
6—Ceramic tubes—vents and wax passages
7—Plug—to be pulled when melt is ready
8—Brick work
9—Grate
10—Wood fire
11—Crucible (clay)
12—Metal being melted
13—Liquid metal
14—Chimney

GOLDSMITHS AND SCULPTORS often, if not always, made a preliminary wax model of any proposed work to submit to the client for approval before starting to cut and hammer expensive materials. So it wasn't too surprising when Benvenuto Cellini got the idea of backing the model with clay inside and out, then melting out the wax and pouring metal in. Whether or not the basic idea was original with him seems unimportant compared to the then-staggering problems of constructing a furnace capable of melting and pouring some hundred pounds of bronze. He relates the procedure he used in his autobiography.

The statue was modeled in clay over an iron skeleton about ½ in. undersize all over. This was covered with wax and brought to final size and shape. Finally, the model was covered with clay and the whole unit was lowered over a fire and baked thoroughly.

For casting, the mold was lowered into a shallow pit and backed with earth. Tubes of pottery were inserted as vents and outlets for the wax and a crucible of clay was built over the mold. An intense wood fire melted the metal, and pouring was accomplished simply by pulling a plug in the bottom of the crucible.

Precision casting is now just beginning to grow up. Its history as an industrial process is very short, but as a tool used by jewelers, sculptors and dentists, it goes back a long way, and much of what is now known is the result of the experiments of these pioneers.

Dentists required crowns of the highest possible dimensional accuracy; they *had* to fit correctly in the patient's mouth, but never was more than one casting required. This requirement stimulated the research work of dental supply firms until investment materials and waxes of zero shrinkage were obtained, so the contour molded in wax in the patient's mouth would be exactly duplicated in gold.

Jewelers were faced with the costly waste of expensive coining and forming dies which had to be scrapped after comparatively short lives because of style changes and the demand for individuality. Precision casting came to their aid by providing a way to make inexpensive intricate castings in small to medium quantities. Surface finish and intricacy of detail were important, but dimensional accuracy didn't matter much. Those interested in this industry developed rubber molds as a cheap way of producing wax patterns in large quantities. Gradually, more and more people with varied technical experience have become interested in precision casting, each because he has some particular difficult problem to solve.

The most recent entrant has been Uncle Sam with a whole multitude of problems, from gas turbines to midget radar parts, and from the highest-temperature unmachineable metals down to magnesium. The sudden war demand brought a very young, immature field into the limelight, and just about stampeded a lot of people, and it will probably take several years more to sift the good developments from the bad.

From the very first the pioneers recognized the potential value of their developments and patented everything. Sometimes, separate lines of development came so close together that friction was inevitable, and even now, litigation is still going on. The foremost licensors each control a complete process from one end to the other, and supply engineering service for getting into operation, but to this date, there has been very little attempt to pool and intermix similar techniques.

Acknowledgment

The following firms have been most generous in supplying information for this report:

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YOUR CHANCES OF GETTING AHEAD

FOR 20 years we have been whittling away the foundations of our economic structure. We have been cutting away the incentives to "get ahead in the world," to increase production and to improve efficiency. Unless this process is reversed soon, we risk the sort of industrial stagnation that currently afflicts Great Britain so disastrously.

How far the whittling has gone is shown by the statement in the center of the page. It shows that everyone's stake in working harder and getting ahead has been reduced sharply since 1929. In that year, anyone who was even moderately successful could look forward to reaping the rewards of his success. If he earned $5,300 annually over a period of 25 years he could retire on a comfortable income of $3,000 per year. Or he could pile up enough capital to go into business for himself. He could fulfill the American dream as phrased by Abraham Lincoln in his first annual message to Congress in 1861:

"The prudent, penniless beginner in the world, labors for wages awhile, saves a surplus with which to buy tools or land for himself, then labors on his own account another while, and at length hires another new beginner to help him. This is the just and generous and prosperous system, which opens the way to all, gives hope to all, and consequent energy and progress, and improvement of condition to all."

Look at the situation today. To retire on an annual income from investment that will buy as much as $3,000 did in 1929, a young man needs to earn over $13,000 a year for 25 years. That's more than 2½ times the income he would have needed in 1929. The same thing is true of acquiring a stake in a business.

Although the dollar income needed for retirement rose 75% between 1914 and 1929, the average person's chances of getting ahead improved. This is because the average man's income was rising; it was double the 1914 level by 1929. So more people were within striking distance of success and security.

Why Try to Succeed?

It was a different story after 1929. The income needed for retirement today is two and a half times the 1929 amount. Meanwhile average incomes are up only 80%. So the average person's chances of achieving success are actually slimmer now than in a generation.

What is more, fewer people actually do achieve success today. Only one percent of all families now have incomes large enough to build up a retirement fund or acquire a stake in a business. In 1929, almost 6% of all families attained a comparable degree of success.

Higher taxes are the most important reason why it takes so much more now to build up a competence. They account for one-half the increase in the amount needed. The other half is explained by higher living costs and lower interest rates.

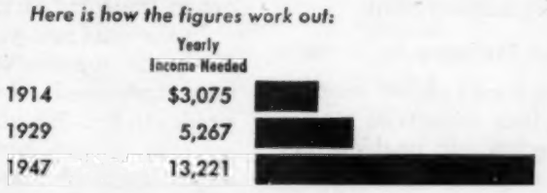
It is, of course, true that few people ever get into the higher income brackets. So the process of cutting away the incentives which play such a key role in our

YOUR CHANCES OF GETTING AHEAD

To see how your chances of getting on in the world have changed during the past few decades, the McGraw-Hill Department of Economics has calculated how much it now takes to save enough to acquire a retirement income or a comparable stake in a business, as compared to what it took in 1914 and 1929.

The objective set is an income from investment equal to $3,000 a year in 1929 dollars. It is assumed that the savings required to yield this income are made over a period of twenty-five years. During that period it is also assumed that $4,000 per year (in 1929 dollars) is spent on living expenses.*

Here is how the figures work out:



It now takes more than four times as large an annual income as it did in 1914 to gain a comparable stake. It takes well over twice as much as it did in 1929.

Changes in three factors — federal income taxes, living costs, and interest rates — explain why the income needed has multiplied so. Here's how these factors line up for the three years.

	Federal Income Taxes Married Man, 2 dependents		Cost of Living (Index Numbers 1935-39)	Interest Rate High-grade Corporate Bonds
	$5,000 income	$10,000 income		
1914	$10	$60	71.8	5%
1929	$3	$40	122.5	5%
1947	$589	$1,862	155.0	2½%

Similar calculations show that if we could reduce federal expenditures from $35 billion to $25 billion annually, raise interest rates by one-tenth and lower living costs by 15% — all realistic possibilities if we make the effort — then the income needed to build up such a retirement fund would come down to $9,500. The chances of realizing that goal would then be restored to what they were in 1929.

*Several other factors were omitted from the calculations because they would not have a decisive effect on the results. Thus, existence of social security pensions now reduces the income needed; but if state income taxes were added, the income needed would increase.

economic system affects comparatively few people immediately. It does, however, have a powerful indirect affect on all of us.

Everybody Loses

When half to four-fifths of any additional income of successful people goes to Uncle Sam a heavy drag is obviously put on doing the work to get it. Thus, we stand to lose the benefit of full use of the nation's best brains. By so doing we stifle industrial progress. And the loss in productive efficiency far outweighs the amount of tax revenue the Treasury gains. Carried far enough, the process of stifling economic progress by slashing rewards leads straight to industrial stagnation.

The same process also multiplies the risks of embarking on new capital investment. High taxes rule out all but the most profitable new projects and restrict most expansions to boom times when profits are high. So capital investment follows a boom and bust pattern and, by so doing, contributes much to ups and downs in production and employment.

The Sorry Plight of Britain

The case of Britain today provides an object lesson of how blighted incentives produce industrial stagnation. *Britain's number one economic problem is to get more production. But the tax load there is so heavy it stifles the incentive to produce more.*

A coal miner who works an extra shift pays about a third of his added earnings to the tax collector. And, as the London *Economist* comments, tax rates on business executives are so high that they kill every incentive except that to tax evasion. In short, not only is the incentive to succeed blighted, but so is the incentive to work.

A root-cause of Britain's trouble is this: The cost of an expensive program of social benefits has been piled on top of the heavy costs of paying for past wars and trying to prevent future wars. Tax rates are boosted accordingly. What her experience proves is that the attempt to provide excessive social benefits may defeat itself. It raises the tax burden on rich and poor alike and smothers the incentive to work. So the underlying basis of all economic benefits—production—is eaten away.

We in the U. S. haven't traveled as far down the stagnation road as Britain has. Taxes amount to about 26% of national income here as against about 45% there. But, unless we start soon to build up incentives to do better work, instead of whittling them away as we have been doing, we will catch up with Britain fast.

It's Late but Not Too Late

Can anything be done? Decidedly yes, *particularly by tax reform and reduction in the cost of living.* As far as interest rates are concerned, any large increase would raise excessively the cost of carrying our war-swollen national debt, and hence raise taxes. But some increase in what are now excessively low interest rates may well be both feasible and desirable.

Action on the tax front is the first order of business. Our jerry-built tax structure is the thing that is chiefly responsible for cutting the incentives to work harder. Two things are important: 1) Government spending must be pared to the bone; 2) The tax system must be completely overhauled to remove the shackles on all-out production.

The 56th editorial in this series, published in March, outlined major steps that need to be taken in remodeling federal taxes in order to increase incentives to individual and business enterprise. *The revenue bill now before Congress is no more than a short step in the right direction. Much more must be done to clear the way for high production and rising living standards.*

Lifting the blight which taxes now place on incentives would help cut the high cost of living. It would stimulate greater production and greater efficiency. But a further step is necessary. Part of the benefits of improved efficiency must be passed on to consumers in the form of lower prices.

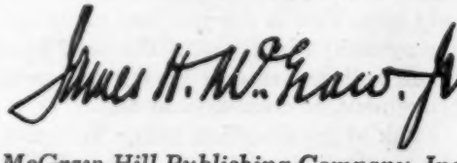
In the past few years we have been following precisely the opposite course. In many cases wages have been increased all out of proportion to increased productivity. Result—soaring prices and a severe squeeze of the consumer, to which some greedy exploitation of war-created shortages has also contributed.

To Give Ability a Chance

Our basic and most crucial problem is to get back on the track which leads to higher production and improved living standards all along the line. We got off that track in the 30's. Then, we started scrambling for larger slices of the same pie instead of trying to produce a larger pie. Now the process of getting back on the track is greatly complicated by the tremendous tax burden growing out of the war.

Yet it's not too late to turn back from the road that leads to industrial stagnation. As the statement in the center of the page shows, we could restore the odds of getting ahead to what they were in 1929. Cutting the federal budget to $25 billion a year and putting the tax structure in good order are the crucial first steps.

By taking these steps soon, Congress can go far to restore the incentives to hard work and efficiency which have been so largely washed away in the past 20 years. If they are not taken the American dream of getting ahead by hard and effective work will exist only in the history books, and our children will inherit from us an economic order without opportunity, without hope. without individual liberty.



President McGraw-Hill Publishing Company, Inc.

TALKING SHOP

Dunking Stopped Delays

BACK before the turn of the century, Wyman-Gordon was forging railway-car couplings in quantity. To their embarrassment, many couplings furnished Canadian Pacific were breaking in the clear, cold mountain air. George Fuller, who started with Wyman-Gordon as office boy and is now board chairman, had heard of a Professor Howe at Columbia University. It seems the professor was heating steel, dunking it in water—and showing this made the steel stronger.

An exchange of letters and some dunking in Worcester put the Canadian Pacific back on schedule—and started Wyman-Gordon developing heat-treating practice.

Ceramic-Metal Solder

GERMANY developed a simple, efficient process for soldering metals to ceramics, according to U. S. Dept. of Commerce. The process could be handled by unskilled labor and permitted quick, accurate assembly of various electronic tubes. Ceramic parts were talcum or magnesium silicate mixed with small amounts of China clay, zirconium dioxide and potassium feldspar. At points to be soldered, parts were coated with molybdenum-iron paste, then nickel-powder solution.

Metal parts were either 54% iron and 46% nickel, or 58% iron and 42% nickel, plated with nickel, then silver. Soldering was done with pure silver.

Three-Point Gaging

DIAMETERS of cylindrical pieces like pistons can be measured by three-point contact with the O.D. One manufacturer handles inspection of three sizes of pistons in this way: He had built a pair of angle blocks with carbide wear strips let horizontally into the 45° surfaces. The two blocks were bolted together to produce a V-block. Then pistons are dropped into the V, resting upon the appropriate pair of opposed carbide strips (according to piston diameter) and a dial-indicator stem brought into contact with the upper side of the piston. The indicator is of course set to zero with a master.

Mistakes

"MISTAKES are the result of definite causes. Time, money and opportunity are lost through mistakes and later attempts to rectify them. To correct mistakes is a good work, but to prevent them is a higher achievement. The ounce of prevention may be applied by a careful consideration of the chief cause of error: carelessness, inattention, superficial interest; accepting appearance as fact, without investigation; proceeding without discussion or advice; impulsive decisions not well thought out; lack of foresight and preparation; forgetfulness and neglect of duty; dependence on those not properly instructed; overconfidence and exaggerated hopes."—Ray L. Morrissey, vice-president and sales manager, Cross Co., at a recent ASTE meeting in Detroit.

Trimmings

MEMORIES of the southwestern monument to the American experiment with camels and the arc-written check, both publicity brainchildren of A. F. Davis of Lincoln Electric, are evoked by a report from New Jersey. There a maker of stainless-steel restaurant counters and similar equipment has discovered that arc-welded beads in scrollwork designs, suitably located and polished, make decorations that please his customers. Meanwhile he finds such decoration easier and cheaper.

Annie Oakley Drawing

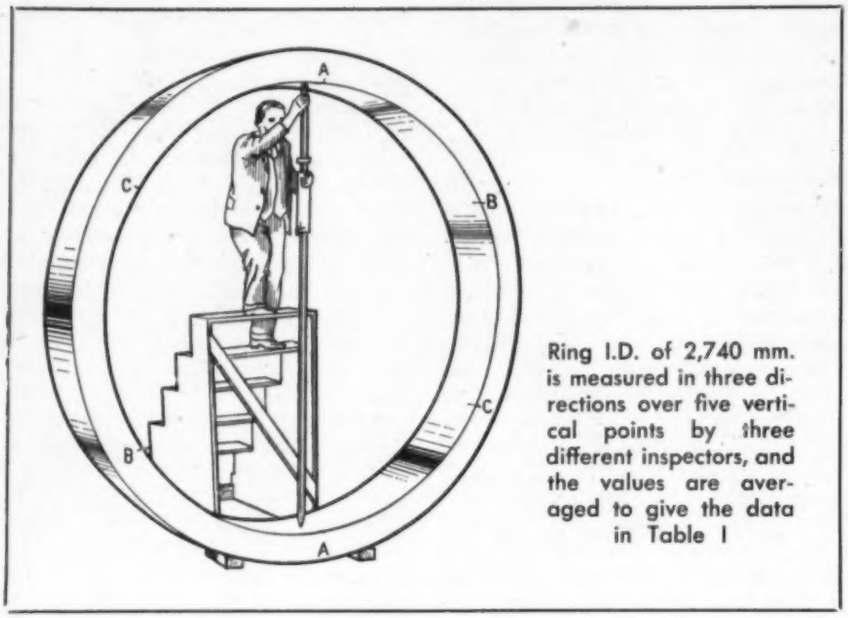
PAYSON BULLARD, speaking at the luncheon which launched Fred Colvin's biography, "60 Years with Men and Machines," told a story of his dealing with General Crozier in World War I. Bullard Co. had a contract for 155-mm. guns, but changes were coming from Ordnance with such frequency guns were not being produced. So Mr. Bullard had an assembly drawing for the gun marked with all changes, and punched a hole beside each change. Then he took it to General Crozier and fastened it in front of a window. It looked like a sieve. "There, General, is the reason you're getting no guns," he said. Mr. Bullard reports subordinate officers were being called in as he left and that changes stopped at once.

Why Not a Circle?

IN THESE DAYS of high building costs, companies are seeking out square plots, so they can build square buildings. An example will show why: Assume a 250,000-sq. ft. working area. If the shape is 1250 x 200 ft., 2900 lineal ft. of wall construction are required. But make it 500 x 500 ft., and walls total only 2000 ft.—a neat saving of 31% in wall length.

If we could make efficient use of a circular building, wall length would drop to about 1772 ft., or a saving over the original of 39% and over the square building of 8% to achieve the horizontal equivalent of the Quonset hut.

Calculations Improve Shrink Fits On Large Gears and Wheels



Ring I.D. of 2,740 mm. is measured in three directions over five vertical points by three different inspectors, and the values are averaged to give the data in Table I

Shrink fits of large parts where high strength and precise shape are desired require calculation of joint strength and tolerances

BY DR. ING. N. N. SAWIN

METHODS of making shrink fits of tires to wheels have long been known and have received international attention. These fits also are used extensively in manufacturing small parts, especially in the manufacture of mechanisms, typing and counting machines and electrotechnical appliances.

Research on these fits, in sizes up to 200 mm., showed that they do not require, in less-critical cases, any close tolerances and particular smoothness of surfaces in the joining parts and that great pressure, outside the elastic limit may be applied during pressing.

The advantage of a hot press fit in these cases is the possibility of mating the working part of the piece, for instance the tire, of a high-quality and expensive material with the fundamental massive part, for instance the wheel, of a cheap material without the aid of wedges and bolts, the tension being equally spread over the surface of the mating parts.

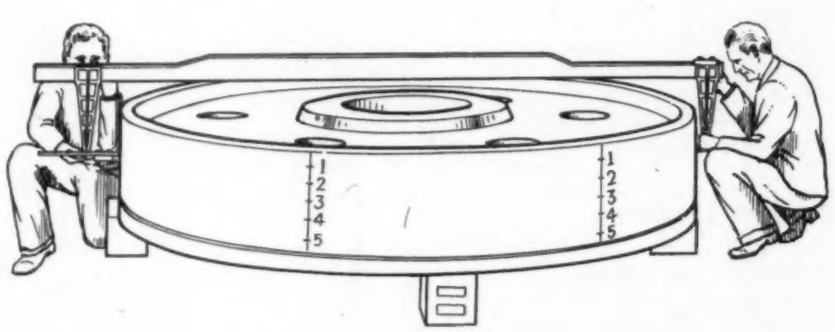
But, in critical cases of high tension in the press joints, and if a precise shape of working surfaces is desired, for example with gears, a shrink fit of a ring of high-quality steel on a wheel of ordinary steel or cast iron requires a preliminary calculation of the strength of the fit and accurate measurements of pieces during manufacturing. In this case, the high cost of the product and the technical responsibility demand great care, particularly in mass production of interchangeable mating parts.

The following information on shrink fits is based on tests, calculations and measurements, which I made in the Skoda Works (Pilsen) during 1942-1943, in manufacturing several pairs of heavy driving gears for rolling mills.

Preliminary Calculations

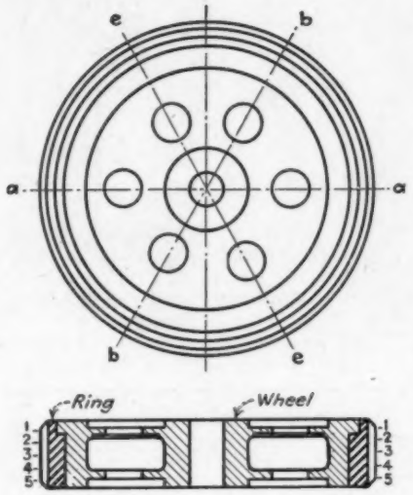
It was established by preliminary calculations that, for transmission of 1,500 hp. at 4.7 rpm. and a maximum 10,000 hp. at 32 rpm., gears must be manufactured by shrink fits of forged steel rings on cast-iron wheels with outside diameters of 2,740 mm. and 1,792 mm. and a negative allowance of 1.80 mm. for the larger gears and 1.40 mm. for the smaller one. Outside diameters for rings must be 3,075 mm. and 2,045 mm., and the length 500 mm.

All parts were machined on vertical boring mills to prescribed tolerances. The values of elastic deformation of both rings and wheels, resulting from tension during machining (by cutting tool and bolts), were previously studied.* They were found by measuring the clamped



The wheel is measured in three directions over five vertical points by a Sawin hollow, wood measuring instrument insulated with aluminum foil

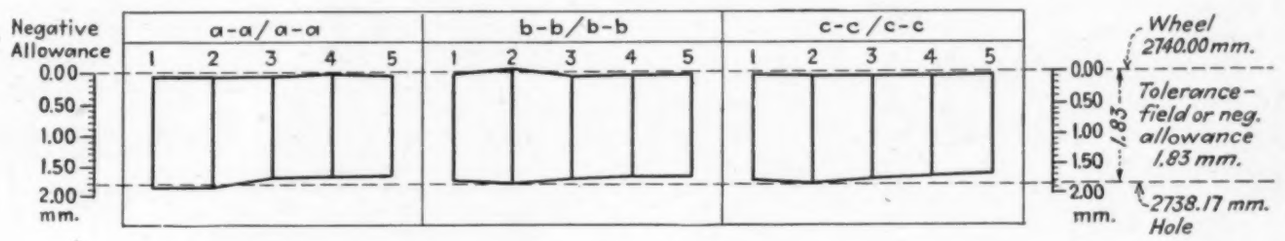
TABLE I — NEGATIVE ALLOWANCE* OF RING I.D. (2738.17 MM.) AND WHEEL O.D. (2740 MM.)



	Ring I.D.	Wheel O.D.	Neg. Allow.	Neg. Allow.	Neg. Allow.	Ring O.D. before pressing	Ring O.D. after pressing	Deformation**
		a-a/a-a		*a-a/b-b*	*a-a/c-c*		*a-a*	
1	2738.16	2739.96	1.80	1.82	1.81	3073.67	3074.99	1.32
2	2738.16	2739.95	1.79	1.86	1.80	3073.64	3074.99	1.35
3	2738.28	2739.96	1.68	1.67	1.67	3073.63	3074.98	1.35
4	2738.34	2739.99	1.65	1.63	1.62	3073.62	3074.97	1.35
5	2738.36	2739.98	1.62	1.61	1.67	3073.61	3074.96	1.35
		b-b/b-b		*b-b/c-c*	*b-b/a-a*		*b-b*	
1	2738.19	2739.98	1.79	1.78	1.77	3073.64	3074.96	1.32
2	2738.17	2740.02	1.85	1.79	1.68	3073.65	3074.95	1.30
3	2738.23	2739.95	1.72	1.72	1.63	3073.63	3074.94	1.31
4	2738.29	2739.97	1.68	1.67	1.70	3073.60	3074.94	1.34
5	2738.29	2739.97	1.68	1.68	1.69	3073.60	3074.93	1.33
		c-c/c-c		*c-c/a-a*	*c-c/b-b*		*c-c*	
1	2738.18	2739.97	1.79	1.78	1.80	3073.62	3075.00	1.38
2	2738.17	2739.96	1.79	1.78	1.85	3073.63	3075.01	1.38
3	2738.23	2739.95	1.72	1.73	1.72	3073.63	3075.01	1.38
4	2738.28	2739.96	1.68	1.71	1.69	3073.62	3075.00	1.38
5	2738.30	2739.97	1.67	1.68	1.66	3073.63	3074.99	1.36

**Pressing of wheels into rings was done in most advantageous position: a-a/a-a, b-b/b-b and c-c/c-c with rings heated to 110 C. to increase diameters by 2.55 mm.*

***Maximum deformations of ring after pressing were in radial direction c-c (1.36–1.38 mm.)*



pieces on the machine and in inspection after their removal from the machine.

These comparative tests showed that, in manufacturing rings, the measuring instrument must be set on the nought line, or nominal dimension, and the wheels machined a little above this line, so dimensions of the pieces, after removal from the machine, did not exceed the limit of the tolerance-field.

Sawin Measuring Instruments

Measurements were made in the inspection room, at a temperature of 20 C., by specially constructed Sawin instruments in three radial directions, *a-a*, *b-b* and *c-c*, and in five transversal sections 1-1, 2-2, 3-3, 4-4 and 5-5, shown in Table I and Figs. 1 and 2. The values are the average results of five repeated measurements, made by three different inspectors, of the ring and wheel for a large gear.

Results of calculations for ring and wheel are shown in Tables II and III. Table II gives the data, together with supplementary drawings and calculations. Table III shows calculations for strength of the fit by use of Foppl formulas for elastic tensions in a thick-walled tube with use of practical coefficients.

In this way, both normal and tangential tensions in press joints were found and values of the necessary maximum and minimum negative allowance for safe transmission of required power and the tolerance of ring and wheel are established.

It was established, by the calculations, that the diameters of both ring and wheel must have the following limit dimensions:

Inside diameter of ring:
maximum = 2738.43 mm.
minimum = 2738.17 mm.
tolerance = 0.26 mm.

Outside diameter of wheel:
maximum = 2740.00 mm.
minimum = 2739.83 mm.
tolerance = 0.17 mm.

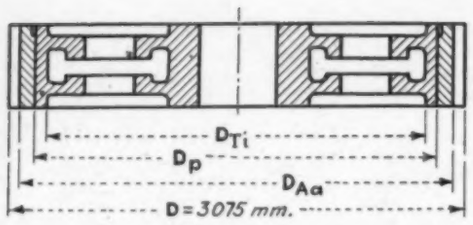
Tolerance of the ring = 0.26 mm., or 260μ where μ = 1/1000 mm. This equals the values of the fundamental tolerance of the 8th grade of accuracy for the range of diameters within 2,500-3,150 mm., which was established in "Interchangeability of Large Machine Parts."

Tolerance of the wheel, or 0.17 mm., or 170μ, corresponds to the 7th grade of accuracy of the fundamental tolerances. The last tolerance may be decreased to the 6th grade of accuracy (105μ), as shown by measurements in Table I. The tolerance-field for the negative allowance, Tables I and II, corresponds to the press fit *T* and *t* in the ISA System of Tolerances.

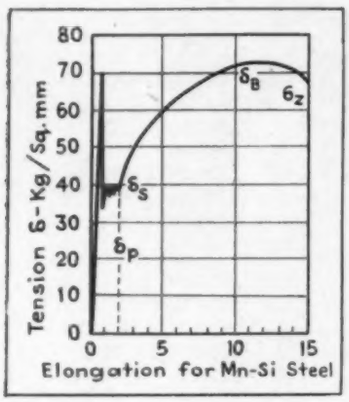
Tensions in shrink fits during milling of gear teeth were considerably less than the maximum permissible tensions in the press joints.

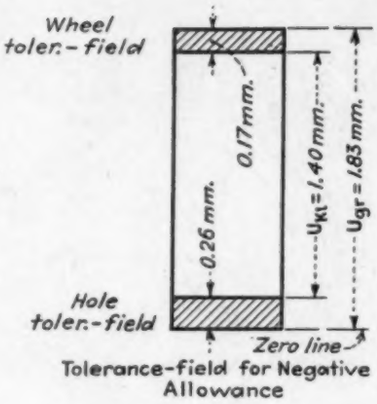
* Sawin, "Interchangeability of Large Machine Parts"—Vol. 91, No. 1, p. 88, American Machinist.

TABLE II — RING AND WHEEL DATA



Press fit of wheel to ring





Tolerance-field for Negative Allowance

	Ring	Wheel	Surface	Outside	Inside
	(Mn–Si Steel Forging)	(Cast Iron)	Roughness H_r = 0.03 mm.	0.03 mm.	
Strength δ_B	65–75 kg./sq.mm.	18 kg./sq.mm.	Loss of neg. allowance ΔU = 0.05 −0.08 mm.		
Yield point δ_S	40 kg./sq.mm.		Precision of measuring G_M = +0.03 mm.		
Modulus of elasticity E	22,000 kg./sq.mm.	7500–10500 kg./sq.mm.	Max. measured neg. allowance U max = 1.85 mm.		
Proportional limit δ_p	20 kg./sq.mm.		Min. measured neg. allowance U min. = 1.65 mm.		
Elongation δ	12 – 15%		Max. actual neg. allowance U_g = U max $-\Delta U + G_M$ = 1.83 mm.		
O.D. I.D.	D_{Aa} 2940 mm. D_{Ai} 2740 mm.	D_{Ta} 2740 mm. D_{Ti} 2610 mm.	Min. actual neg. allowance U_k = U min $-\Delta U - G_M$ = 1.51 mm.		
Ratio $(O.D./I.D.)^2$	Q^2_A 1.15	Q^2_T 1.1	Deformation after pressing e_{Aa} = 1.38 mm.		
Ratio $(I.D./O.D.)^2$	Q^2_{Ai} 0.87	Q^2_{Ti} 0.91	Max. permissible neg. allowance U_{gr} = 1.83 mm.		
Poisson's value	$M_A = M_T$ = 3.33		Min. permissible neg. allowance U_{kl} = 1.40 mm.		
Length Fit seat	L = 450 + 50 = 500 mm. F = 4,301,800 sq.m.		Fit tolerance P = 0.43 mm. Hole tolerance T_H = 0.26 mm. Shaft tolerance T_W = 0.17 mm.		
Rel. neg. allowance	$U_{gr} \div D_F$ = 1.83 ÷ 2740 = 0.00065 mm.		Wheel O.D. = 2740, + 0.00 − 0.17 Ring I.D. = 2738.17, + 0.26 − 0.00		

CALCULATIONS IMPROVE SHRINK FIT ON LARGE GEARS AND WHEELS

Continued

Deformation of the gear after milling is inevitable, but the value did not surpass the tolerances allowed for safe and noiseless operation of the gear.

The smaller gear was manufactured also by a shrink fit of a forged steel ring on a cast-iron wheel, the calculations both preliminary and checking being made by the same formulas.

The principal results of calculations are given here:

RING SPECIFICATIONS

Inside diameter	=	1790.70 mm.
Max. "unroundness"	=	0.08 mm.
Max. conicalness	=	1.13 mm.

WHEEL SPECIFICATIONS

Outside diameter	=	1792.00 mm.
Max. "unroundness"	=	0.03 mm.
Max. conicalness	=	0.15 mm.
Max. neg. allowance	=	1.4 mm.

The ring was heated to 160 C. to increase its diameter by 2.55 mm. before pressing. Increase of the outside diameter of the ring after pressing was 0.99 mm. The loss of negative allowance because of surface roughness was only 0.075 mm. The normal pressure in the press joints was 0.746 kg. per sq. mm., and the tangential tension in the inside press joints was 7.750 kg. per sq. mm.

Allowance

Max. permissible neg.	=	0.43 mm.
Min. permissible neg.	=	1.08 mm.

Tolerance

Fit—1.42-1.08	=	0.34 mm.
Hole	=	0.21 mm.
Shaft	=	0.13 mm.

The gears, made to the above calculated dimensions and consisting of interchangeable parts, are still operating satisfactorily.

TABLE III

Desired: Diameter of press joints = 2740 mm.; press fit; neg. allowance = 1.80 mm.; elastic deformation; power transmission = 1,500 hp. at 4.8 rpm.

Calculations* (See Table II); Normal tension p_w in press joints is the same for both outside and inside parts in proportional ratio to changes in diameter, as, for instance, the increasing e_{Aa} of ring O.D.

	FORMULAS	CALCULATIONS	
Change in ring O.D. Normal tension in press joints, ring and wheel	$e_{Aa} = p_w \times \frac{[(M_A + 1) + (M_A - 1)]\, Q^2_{Ai}}{M_{Ai}\, E_A\, (1 - Q^2_{Ai})} \times D_{Aa}$	$1.38 = p_w \times \frac{[(3.33 + 1) + (3.33 - 1)]\, 0.87}{3.33 \times 22000\, (1 - 0.87)} \times 2940 = p_w \times 1.97$ mm.	
	$p_w = \frac{e_{Aa}\, M_{Ai}\, E_A\, (1 - Q^2_{Ai})}{(M_A + 1) + (M_A - 1)\, Q^2_{Ai} D_{Aa}}$	$\frac{1.38}{1.97}$	= 0.70 kg.
Tangential tension in inside press joints of ring	$V_B = p_w \times \frac{Q^2_{Ai}}{(1 - Q^2_{Ai})} \times \frac{\chi^2 + \left(\frac{D_{Aa}}{2}\right)^2}{\chi^2}$ where χ = all values from $\frac{D_{Aa}}{2}$ to $\frac{D_{Ai}}{2}$; $\chi = \backsim 1420$ mm.	$0.70 \times \frac{0.87}{(1 - 0.87)} \times \frac{1420^2 + \left(\frac{2940}{2}\right)^2}{1420^2}$	= 9.70 kg.
Safety condition for inside press joints of ring	$p_w + V_B \leq 6$ p (by Mohr)	$0.70 + 9.70 \leq 20$	= 10.40 ≤ 20 kg./sq. mm.
Max. permissible tension in ring joints	$p_{gr} = \delta_p \times \left(\frac{1 - Q^2_{Ai}}{1 + Q^2_{Ai}}\right) \times 0.4$	$20 \times \frac{1 - 0.87}{1 + 0.87} \times 0.4$	= 0.56 kg./sq. mm.
Max. (calculated) permissible neg. allowance	$U_{max} = p_{gr}\, (K_A + K_T)\, D_{Ai}$ where	$0.56\ (0.00067 + 0.00045)\ 2740$	= 1.72 mm.
	$K_A = \frac{[(M_A + 1) + (M_A - 1)]\, Q^2_{Ai}}{M_A\, E_A\, (1 - Q^2_{Ai})} = \frac{[(3.33 + 1) + (3.33 - 1)]\, 0.87}{3.33 \times 22{,}000\, (1 - 0.87)} = 0.00067$		
	$K_T = \frac{[(M_T + 1) + (M_T - 1)]\, Q^2_{Ti}}{M_T\, E_T\, (1 - Q^2_{Ti})} \times C = \frac{[(3.33 + 1) + (3.33 - 1)\, 0.91}{3.33 \times 8{,}500\, (1 - 0.91)} \times 0.5 = 0.00045$		
	C = 0.5 for double row of wheel spokes		
Max. (meas.) permissible neg. allowance	$U_{gr} = U_{max} + \Delta U + G_M$	$1.72 + 0.08 + 0.03$	= 1.83 mm.
Pressing force	$P_S = \frac{2 \times l}{D_{Ai}}$	$\frac{2 \times 239250000}{2740}$	= 174600 kg.
Min. permissible tension in ring joints	$p_{kl} = \frac{P_S}{F V_S}$ where $V_S = 0.09$	$\frac{174600}{4301800 \times 0.09}$	= 0.45 kg.
Min. (calculated) permissible neg. allowance	$U_{min.} = p_{kl}\, (K_A + K_T)\, D_{Ai}$	$0.45\ (0.00067 + 0.00045)\ 2740$	= 1.38 mm.
Min. (meas.) permissible neg. allowance	$U_{kl} = U_{min} + \Delta U - G_M$	$1.38 + 0.05 - 0.03$	= 1.40 min.
Fit tolerance	$P = U_{gr} - U_{kl}$	$1.83 - 1.40$	= 0.43 mm.
Hole tolerance	$T_H = 0.6\ P$	0.6×0.43	= 0.26 mm.
Shaft tolerance	$T_w = P - T_H$	$0.43 - 0.26$	= 0.17 mm.

A. Foppl, Vorlesungen uber technische Mechanix III Bd, 6 Aufl, ¶58:Elastisch, Spannungsanstand in ein dickwand. Rohr DIN E 7190, 7182 Bl. 3 June 1942, Rechenrordruck fur einfache Presspassungen.

Whose Job Is Labor Relations?

This discussion of a Round Table topic offers a practical approach to grievance problems and a simple solution — cooperation

BY A. F. SCOBLIC
CHIEF TOOL ENGINEER, THE HEIL CO.

A LABOR Relations Department in any plant may be compared with the Supreme Court. Such a department should be confronted with only the more serious problems or grievances, where the technicalities involved have reached a point beyond the ability or authority of the foreman to handle. The Labor Relations Department, with its trained personnel, is especially well versed in conditions of union contracts and points of law regarding these conditions. Cases such as breach of contract, transfer of employee and those involving two or more supervisors, should definitely be turned over to the Labor Relations Department.

Because of the close personal contact between individual and foreman, the foreman should be the first to know of any grievance—either large and small. If the foreman is alert and has good judgment, he can in many cases settle it. By refusing to listen to, or to make an attempt to settle, a simple grievance, the foreman is losing the one thing he needs most—respect. The man in the shop who respects his foreman will usually accept his decision and be better satisfied than he would if the decision came from a front-office someone who knew him only by number. The foreman who hesitates to offer a solution to a grievance is shirking his responsibility as a leader of his men. He's giving himself a stab in the back.

Many men in the shop will select, of their own choosing, a supervisor whom they feel they can trust and who will work with them on difficulties. Their selection SHOULD be their foreman, but oftentimes it is not. If the foreman "cannot be bothered," the shop man naturally seeks a higher authority to consult. To this worker, his foreman is merely a person who tells him which job to take next.

Often, a shop man will hesitate to report a grievance for the simple reason that he does not care to bring office personnel into the picture. As a shop man, he would rather let the matter drop. Shop men who have this attitude are usually not too hard to deal with. Their troubles are generally small and their grouchy periods short-lived.

When the foreman is unable to clear up a grudge, he might well try the "praise" angle by digging up material which will compliment the worker and thereby ease the tension. With proper procedure on the part of the foreman, it is very possible that the shop man will soon forget his original grumble. Grievances of this type should never reach the Labor Relations Department. If they do, the man is soon labeled as a trouble-maker (as far as the office is concerned), while in reality, something is lacking in shop supervision.

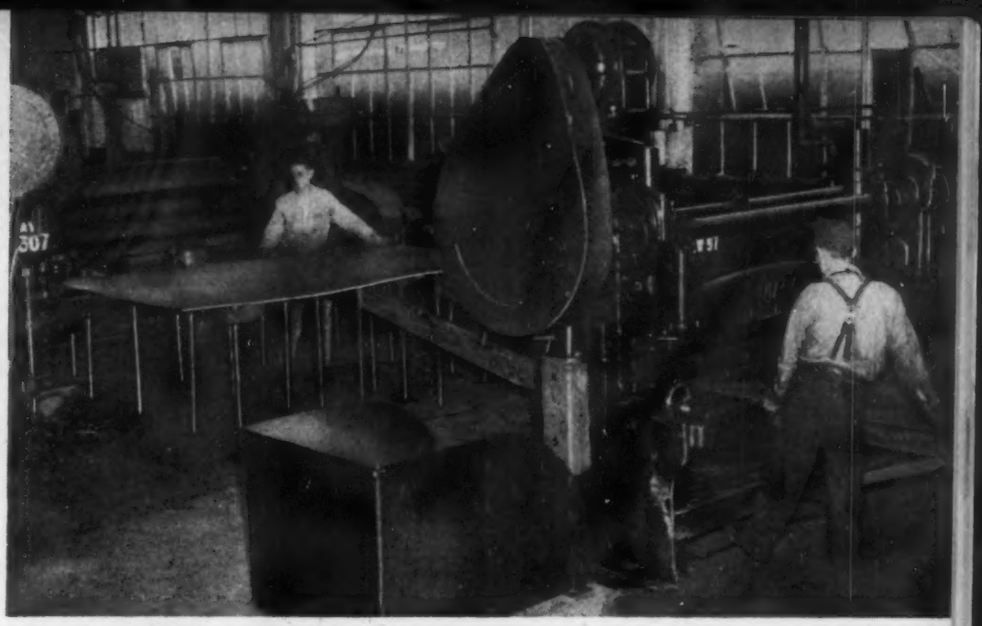
On the other hand, there are men in the shop who seem to enjoy making trouble for others. They understand neither the value of cooperation nor common shop courtesy. Where men have incessantly shown this attitude, little attention should be given them. Under these conditions, I would favor a quick decision by Labor Relations, with the foreman being given the authority to enforce it.

Some months ago, while walking through the shop, I became interested in a series of rather forcible statements between a drillpress operator and his foreman. I paused to listen. After the argument had died down, I met the foreman in another part of the shop and asked what the trouble was. He informed me that the man had been with the company for seven years and had never started a job without grumbling. I then went to see the operator and was given *his* version. In my estimation, his squawks were thoroughly justified. It was a comparatively simple matter to satisfy his desire; which was done in short order. He was not "squawking," but SUGGESTING, that something be done about certain conditions.

The next time this operator had a complaint, it was in a much less severe tone of voice; and again he was taken care of. After a few more reasonable complaints had been handled properly, his attitude was different. In this manner, a seven-year grumbler was tamed in a few short weeks. Some kind words and a little help in getting his difficulties ironed out, was all that was needed to do the trick. He had good ideas and turned out to be a hard worker, steady, and a fine producer.

What could the Labor Department do about such a case? I would say, "too little and too late." By the time the grievance is written up and put through channels, and Labor Relations decides to act upon it, the job in question will in most cases be finished. Too many details and too much red tape will delay the action to such an extent that the final results may justly be considered a "flop."

Nip grievances in the bud, and save a lot of time and trouble for everyone. Long strides have been made in modern machine tools. Why not practice similarly efficient production methods in handling grievances by solving MOST cases with the LEAST effort and expense to the management? The Labor Relations Department should encourage foremen to do all they can while giving them help and keeping them posted on current events. This system lets shop men work together. They keep their battles on the home front, as much as possible—and avoid the red tape.



BALL TRANSFER HEADS, mounted in takeoff rails and posts, enable sheets to be moved rapidly from the shear and positioned against a positive stop for punching two 2-in. dia. holes for filling and gaging. The sheet is swung around to the drillpress, opposite the punch where, locating from a punched hole, a ¼-in. drain plug hole is drilled. Operator moves sheet into pyramid rolls, where body is formed

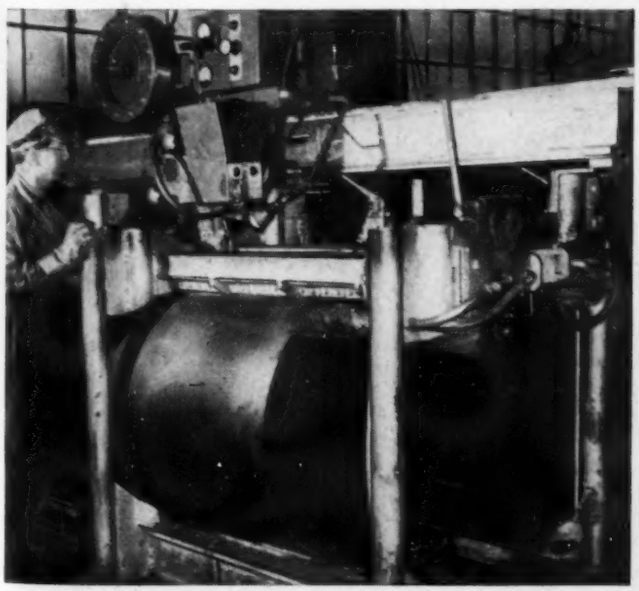
Work Flow Speeds Job-Shop Welding

Sheet-metal "filling stations" turned out on production line basis by integrating materials-handling equipment and welding fixtures

PETROLEUM products storage and dispensing units being fabricated by American Welding & Manufacturing Co., Warren, Ohio, may be a boon to the farmer, but from a manufacturing point of view the variety of operations required on the bulky, low-priced unit was a special problem in methods analysis.

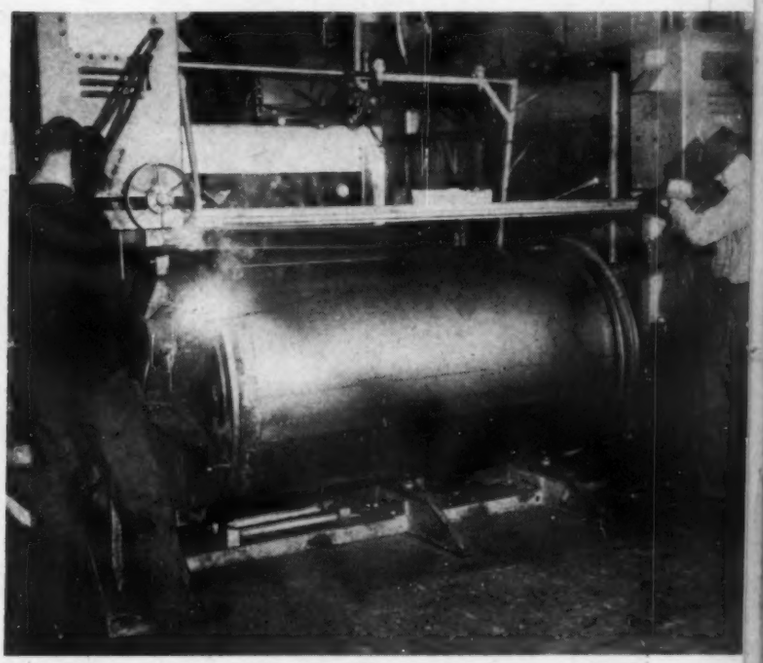
High production was made possible by integration of fabricating, welding, testing and finishing operations into a single continuous production line, which, in addition to conserving manhours, requires relatively little floor space. While maximum production was the goal, it was essential that the company, turning out a continually changing variety of welding projects, retain sufficient space for new jobs.

Mounted roller heads, gravity conveyors, an overhead tram, pneumatic jib crane and rollers speed handling between operations. Automatic welding is used in the line, but paced to the slower operations along the line to keep the work in constant flow to the shipping area. Tooling and fixtures were made flexible for various sizes of tanks.



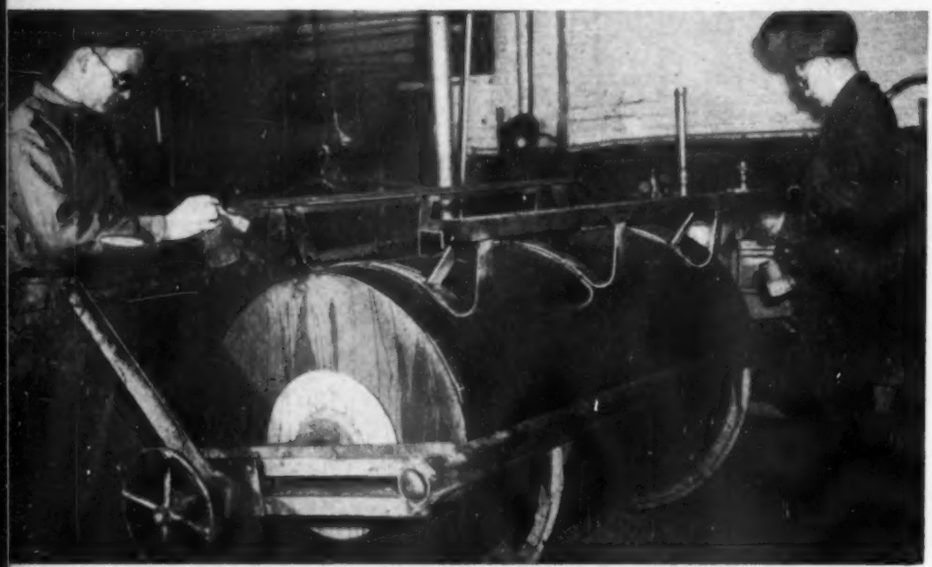
AUTOMATIC WELDING of the 6-ft. longitudinal seam at 6 fpm. follows the forming operation and the body is merely rolled to the welder. The positioning fixture, actuated and clamped by compressed air, is made adjustable to handle any kind of tanks from 10 to 36 in. in diameter and varied thicknesses

TANK HEADS are now pressed into the body in an assembly fixture, both heads being placed over the body by pneumatic cylinders. The heads are tack-welded to the body by two operators



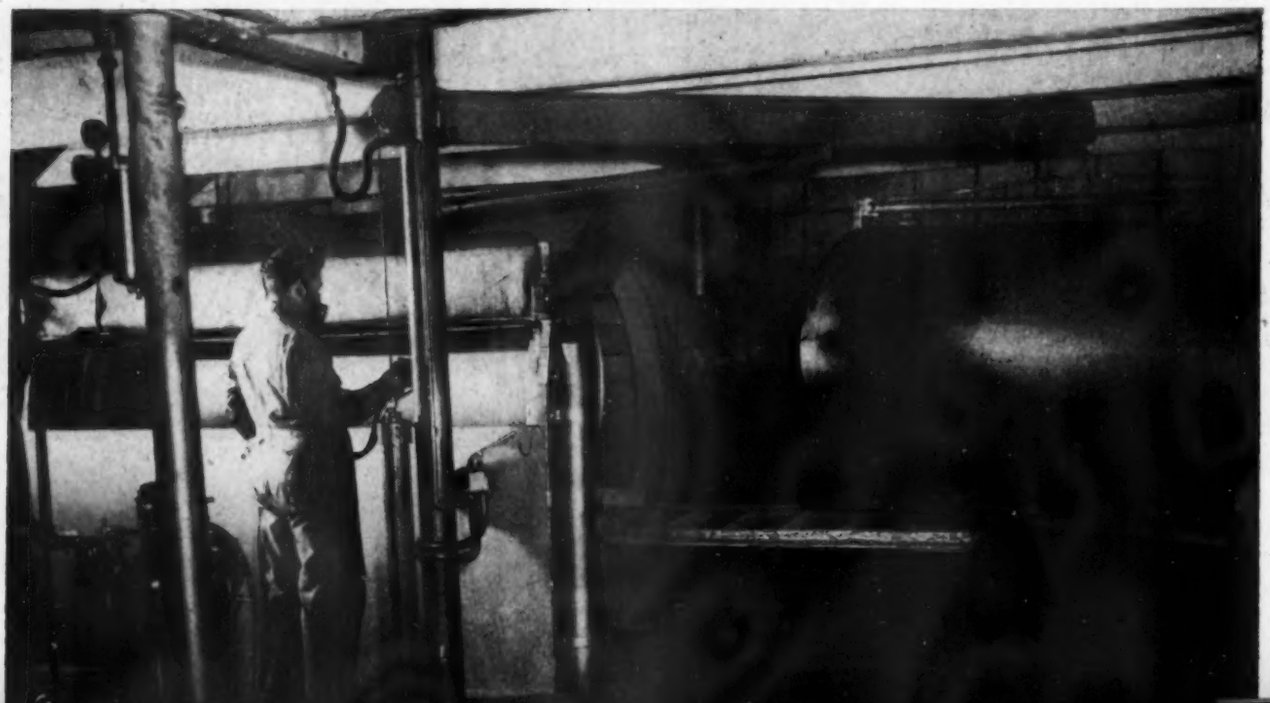
TANK HEADS are automatically seam-welded at a speed of 6 fpm. A variable-speed drive is arranged to take head diameters from 18 to 36 in. Copper backup rings are used

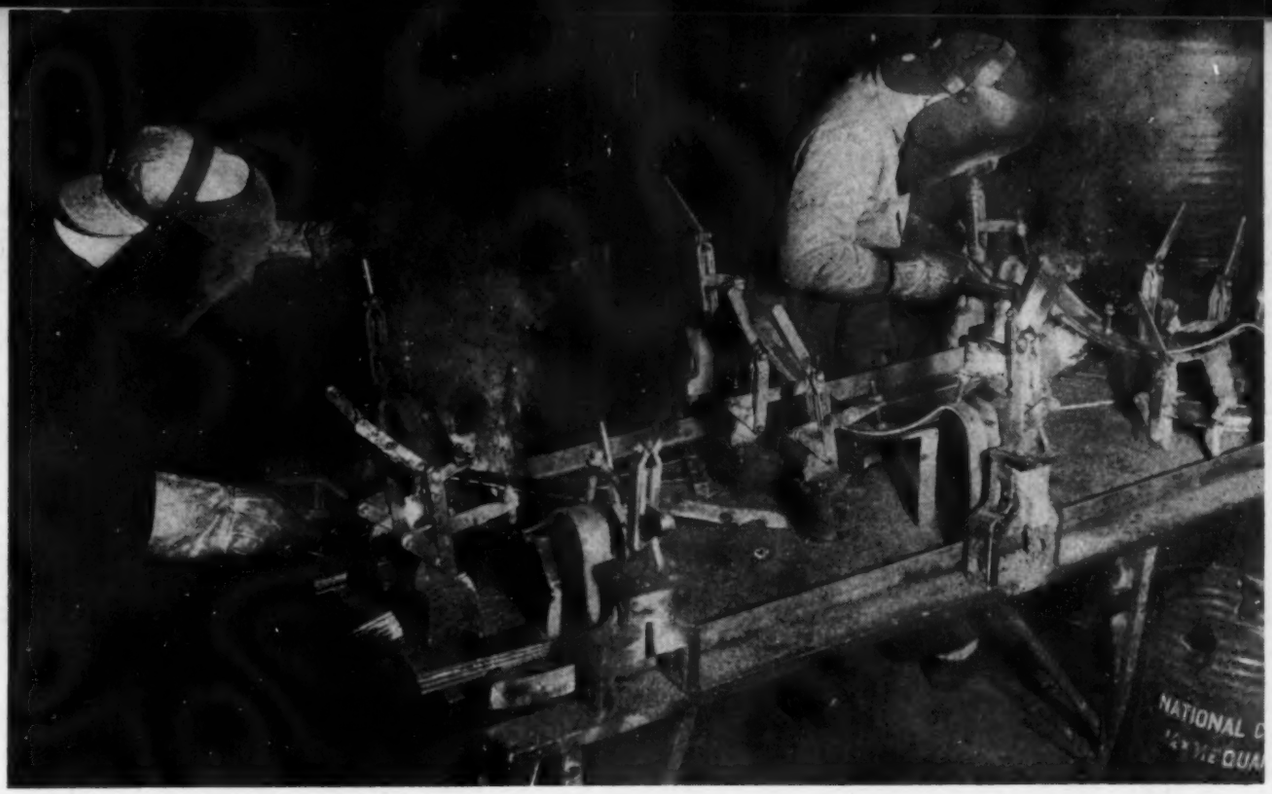
SADDLES and superstructure elements for the tanks are subassembled in production welding fixtures directly across the hall from the station where they are assembled to the tank



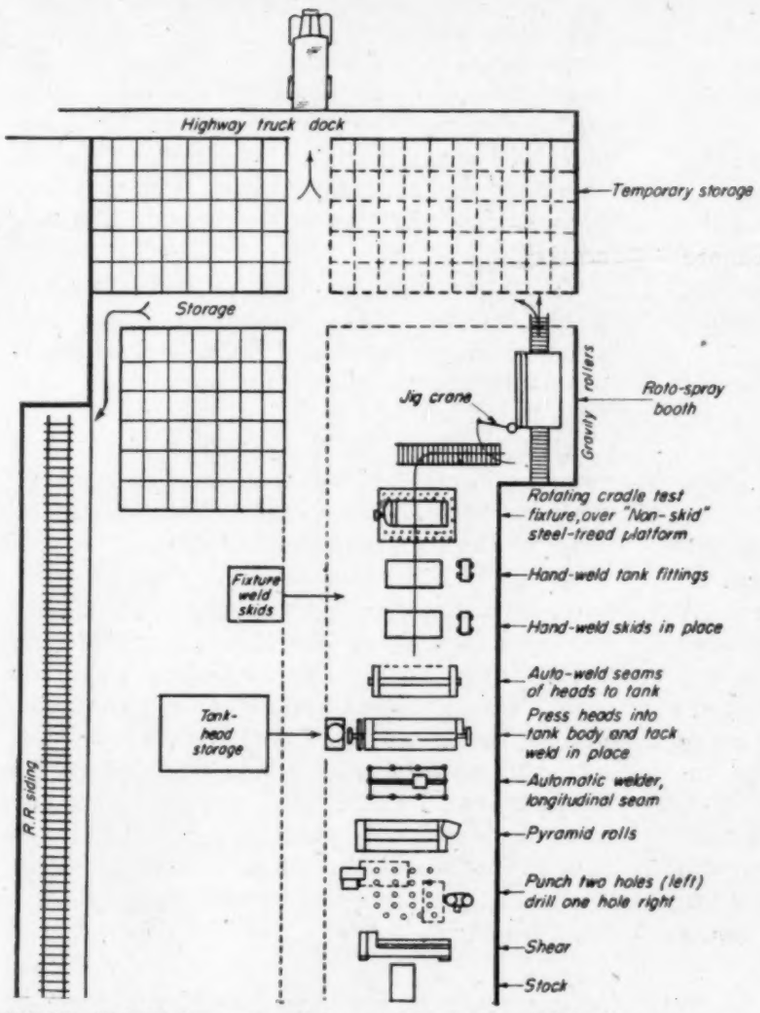
SEAM INSPECTION is speeded up by the use of a special rotating fixture which is suspended from the ceiling. Rotation is by hand and the overhead tram picks the tank up after the fixture is opened out for next step

TRAM AND ROLLER CONVEYOR move the assembled tank to the spray booth, where a jib crane with a pneumatic holding fixture lifts the tank and swings it onto the gravity conveyor which travels through the spray booth. The booth has a rotating fixture which revolves the tank past the spray window during longitudinal travel

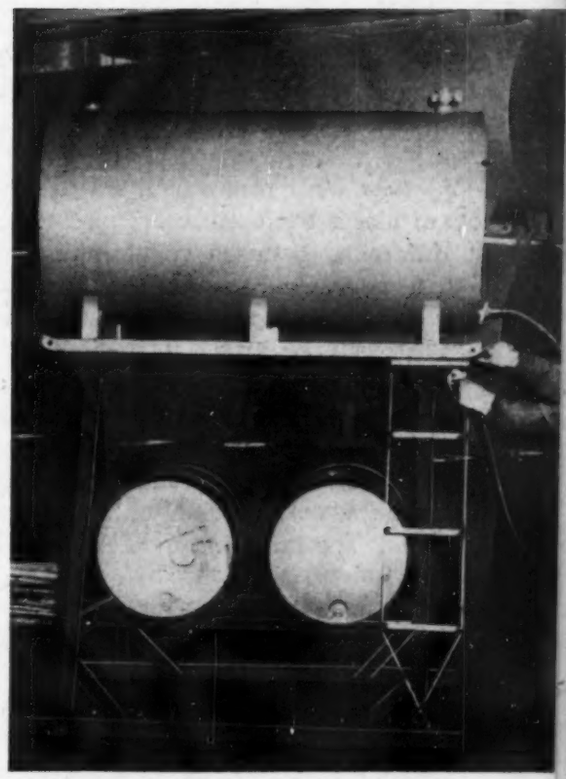




TANK SKIDS are assembled in a clamping fixture for rapid production and ready feeding of the main production line. This operation is performed directly across the aisle from the skid-welding station

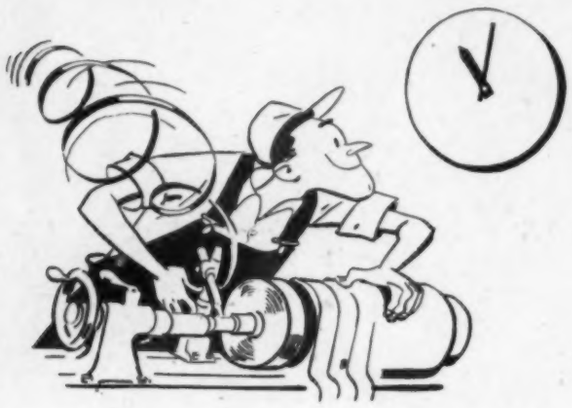


FLOOR SPACE is conserved to a minimum for fabricating, welding, testing and finishing operations on petroleum storage tanks. While turned out in production quantity, the manufacture of these tanks does not interfere seriously with the jobbing-shop output of the company. Materials-handling devices keep production in a constant flow and eliminate unnecessary storage space, which is at a premium



A COMPLETED GRAVITY DISPENSING UNIT mounts a large gasoline tank above, and two 55-gal. drums for kerosene and lubricating oil on the rack below. "A" frames and ladder, shipped separately for assembly on location, are fixture-welded in a manner similar to those used for skids outside of the production line

ROUND TABLE



Piecework in the Toolroom?

"Say, Ed, I read a pretty good article last night about an outfit that was paying piecework in the toolroom. Suppose they'll ever try that here?"

"Piecework? You mean just like it is out in the shop, Al?"

"Well, not exactly. They call it an incentive system, but it's practically the same. The more work you do, the more pay you get. Sounds good to me. Don't know why it wouldn't work here."

"I know what you mean, Al. It's been tried lots of places but usually dropped. There's a lot of difference between regular production and skilled work. In here, you have to take things slow and easy. Rush 'em and scrap 'em."

"That can be true on production, too, Ed. You're not supposed to rush. You save time by staying on the job more and taking little short cuts. Take that big gear-grinding job. The boys save time by loading the arbors and even burring while the wheel's sparkin' out. There's all kinds of tricks. The man that uses his head can make more money. I think that an incentive encourages him to use his head more."

"I know what you mean, Al, but a toolmaker doesn't do the same things over and over. He has to figger things out, and that takes time. Speaking of that, how could rate setters time a job? How could they time a man on figgering things out or doing something different all the time?"

"That's easy. They have records on just how much was spent for work on similar tools before. They just estimate each job from that, and the company and the toolmaker split the difference."

"Estimating like that's not very accurate, Al. Besides, as the work was done faster, the estimates could get lower and lower and nobody'd make any money except the company. Then listen to the howls."

"That could be, but doesn't have to be. If a company is not fair or honest it sure wouldn't work, but I think most companies would be satisfied with their share of the saving."

"O. K. Even if that's true, it's hard to prove to the men that they're not getting gypped. How is it out in the shop? If somebody isn't kicking about a rate, the Big Boss is kicking about the scrap. The foreman has just one big headache. I like it better just the way it is right here."

"I think you're stretching a point, Ed. Sure, the incentive could cause little troubles, but they could be ironed out. More money and the savings in time are well worth it. I think if you set it up to fit the plant and handle it right, everybody benefits."

WHAT DO YOU THINK? *Are incentive systems practically applicable to the skilled trades, or are they a "headache?" Have you had experience with incentive system in toolrooms? Other readers will be interested in your experiences and opinions. Discussions of earlier topics appear on later pages.*

Practical Ideas

Automatic Tension Nut Improves Hacksawing

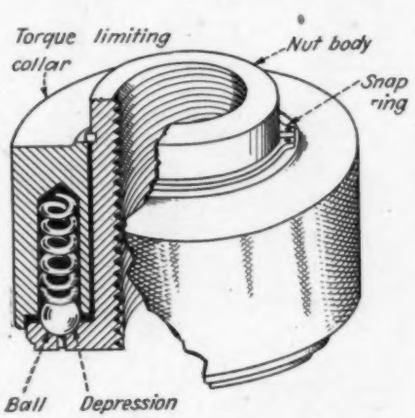
D. E. McDONALD
Sunnyside, Long Island, N. Y.

Very few users of hacksaws understand the importance of securing the proper tension on a hacksaw blade. A hacksaw blade which is over- or under-stressed is subject to breakage and short life.

In order to prevent such conditions, I have designed and built a clutch nut which has proved a very satisfactory means of securing the proper hacksaw blade tension.

The nut proper screws over the blade hook bolt and does the holding, but this nut is turned by means of a knurled collar which fits loosely over the nut. The collar carries a small steel ball which is pushed forward by a 30-lb. compression spring into a 35% recess in the flange of the nut proper. Using a 3/16-in. ball the recess would be about 0.0655 in. deep. A snap ring holds the two members together.

In operation the clutch nut is screwed onto the hacksaw tension screw and brought up against the frame until the ball disengages from the cavity, at which time no further tightening of the screw can be effected and the knurled sleeve member will continue to override the nut itself.



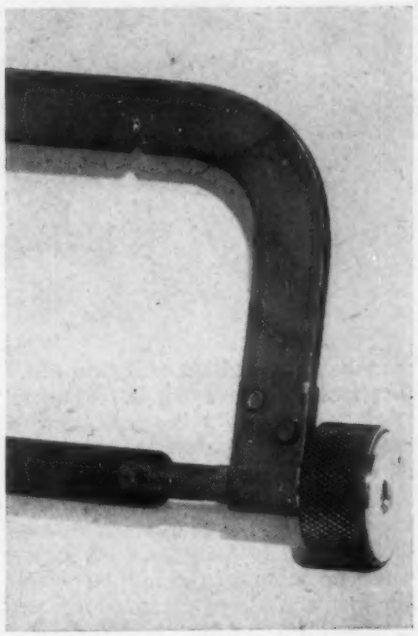
Clutch automatically disengages when torque exceeds the spring pressure holding ball in the nut cavity

In removing or loosening the clutch nut, the outer member is pulled back hard when the ball is in its cavity, thus forming a more positive drive between both the outer and inner members. The nut is only held in this position until it is loosened, at which time the back pressure may be released and the nut removed in the usual manner.

It is recommended that the inside shoulder face of the inner member be case-hardened in order to reduce wear. This compression spring may be experimented with in order to secure the various tensions on the blade that are desired. It has been found by experience, that a compression spring having between 20 and 30-lb. pull was desirable. The depth to which the hole in the outer member should be drilled depends upon the length of the spring and, in most instances, it should not exceed an over-all length of more than ⅜ inch. The outside diameter of the spring should not exceed 3/16 in. and the drill hole should provide clearance. Therefore, it is recommended this hole be 7/32 in. in diameter.

Exact proportions, especially the spring characteristics, will have to be worked out until the nut releases at just the right tension. (Blade manufacturers should be able to supply this information for each blade.) A nut so calibrated should be marked or identified and then be used only with blades of that tension, and different nuts should be provided for other blades.

Wear will be high in the ball depression and surrounding ring, so hardening is recommended.

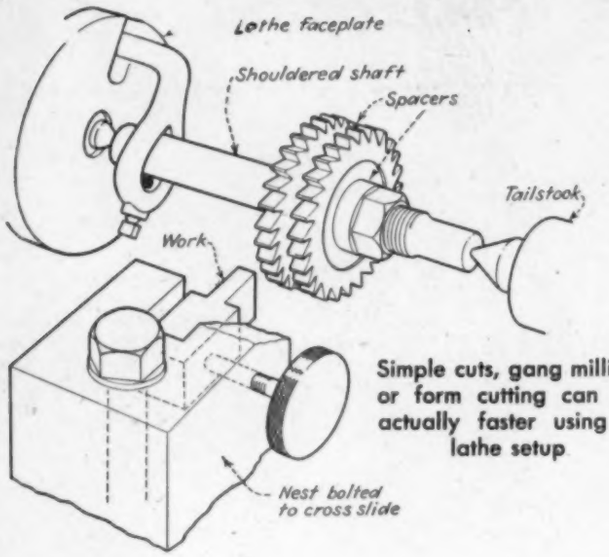


Neat, knurled tension nut will always hold hacksaw blade at correct tension

Lathe Milling Can Be Practical

ROGER ISETTS
Kenosha, Wis.

During the war, I worked in a small jobbing shop in which several lathes, a few drillpresses, a shaper, and a milling machine were about the extent of the equipment on hand. A milling job came through from the government which called for 50,000 small links—and of course they wanted them in a hurry. As we had only one milling machine, and that was almost always tied up with larger jobs, we were about ready to turn the job down. Then one of the men suggested that it might be possible to do it on one of the engine lathes which wasn't busy at the time. At first this seemed impractical. But on closer study we decided to give it a try. Of course, there were those who did considerable scoffing, especially as it had to be a high-production setup. To satisfy



Simple cuts, gang milling or form cutting can be actually faster using a lathe setup

ourselves we built a makeshift fixture and a cutter arbor out of scrap stock we found lying around the shop. Surprisingly enough, it worked extremely well. We improved it a little and went ahead with the order. We averaged 125 pieces per hour—which actually was faster than we could do them on the mill. The order was completed in less than the required time, and all the pieces conformed to government specifications.

The arbor and fixture are not at all complicated to make. For the arbor body we used a round piece of cold-rolled and centered both ends. We turned it down to fit the hole in an ordinary milling cutter. Then we cut a thread on it for a lock nut used to draw the cutters up tight. We cut keyways in the shaft and keyed the cutters to it.

For the fixture, a square piece of machine steel was used, and a pocket was milled in it to receive the work. A hole was drilled from the top for a clamping bolt used to secure the fixture to the lathe compound. In the side, a hole was tapped for a thumbscrew to hold the work in place. The fixture was easily loaded and unloaded and the feed was set as high as was practicable. For coolant we used a heavy black oil in a slow stream on the cutters.

There are an unlimited amount of similar jobs that can be just as effectively performed on a lathe as this one. With a little originality and imagination the lathe's maximum versatility can be realized. Remember, all milling jobs don't require vertical feeds.

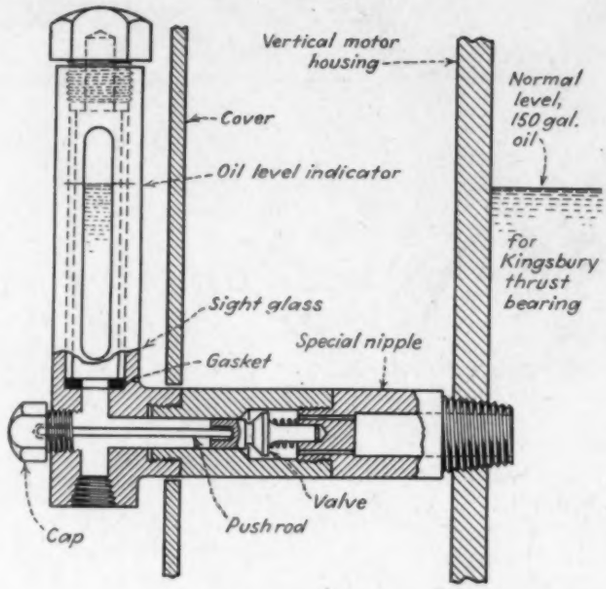
Plunger Check Valve Simplifies Glass Renewal

W. RICHARDSON
Upland, California

Lube oil sight glasses projecting from large machinery casings, like our 6 12,000 hp. vertical motors are easily broken accidentally, and every time this happens, or whenever the indicator has to be removed for cleaning or gasket replacement, we have to drain 150 gal. of oil.

This annoyance was eliminated by installing a horizontal, plunger-actuated check valve under each sight glass which automatically closes whenever the glass is removed.

The valve is a plain mushroom held in the closed position by a spring and held open by a pushrod backed up by a pipe plug in the indicator fitting. Once the special nipple, which guides the valve stem and holds the valve spring, and the valve are installed, they never have to be removed except for major overhaul, but the indicator or any other similar external device can be removed at any time without disrupting the rest of the system.



Built-in check valve makes it possible to remove external fittings from a large oil reservoir without spilling or draining the oil

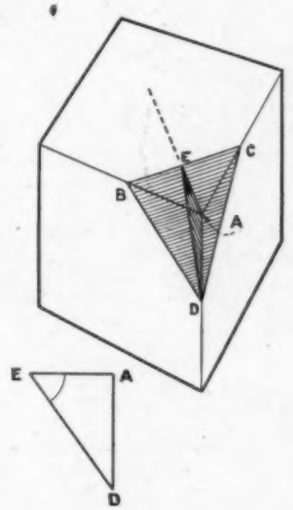
How to Cut a Corner Chamfer

F. W. BRADY
Scranton, Pa.

We started to machine the corners of a cubical forging to produce an angle of 45° on each of the three faces. The angles were never alike from a trial-cut method, so the problem was analyzed and the proper angle for the tilt of the chuck calculated.

Shaded area, BCD is the desired cut and lines BC, CD, and BD all must cut their corners at 45°. The direction of the cut will be perpendicular to line BC or in plane EAD, so it remains to find angle E.

1. $AE = AB \sin 45$ or $AD \sin 45$.
2. $\dfrac{AD}{AD \sin 45} = \tan E$
3. $\text{Tan } E = \dfrac{1}{\sin 45} = \dfrac{1}{.707} = 1.414$
4. $E = 54° 44'$.

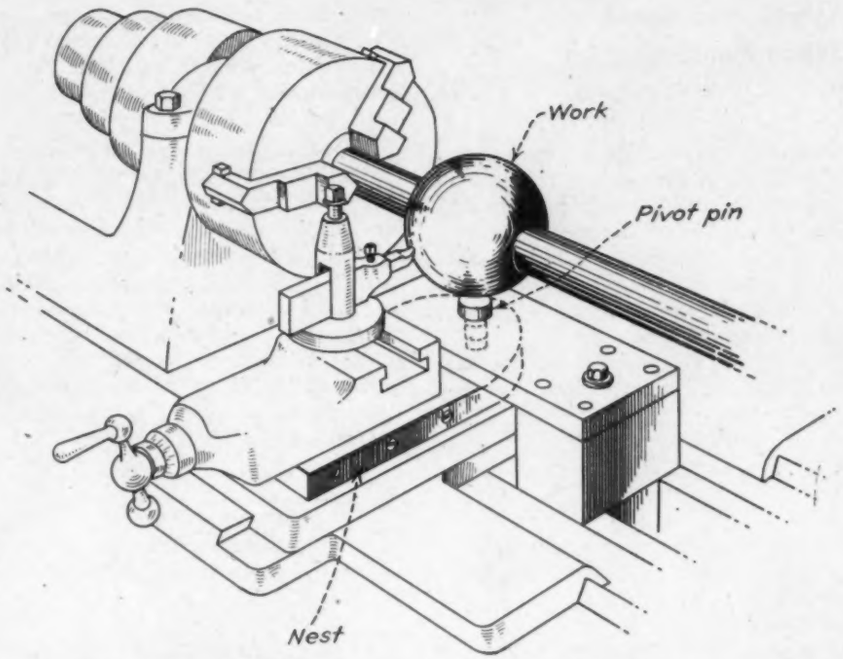


Ball Turning Attachment Uses Power Feed

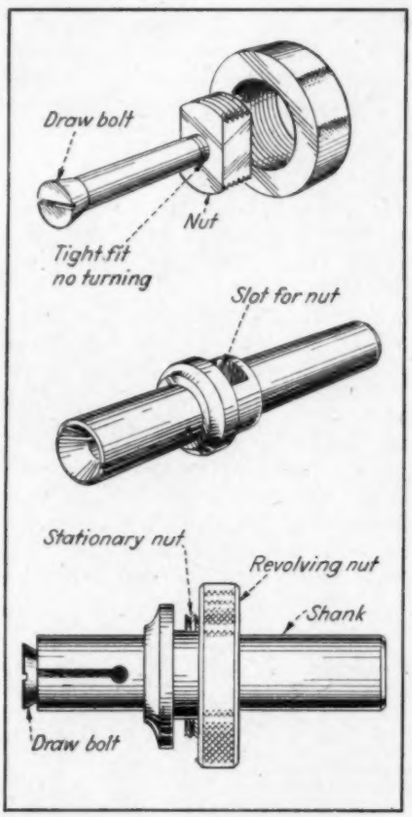
GEORGE A. GILLER
Glen Ridge, New Jersey

We had to turn a lot of 12-in. diameter balls for some Navy hydraulic motors as a result of which this self-feeding attachment was developed.

A large block straddling the inner ways carries an overhanging plate with a downward projecting circular stud, the whole of which is clamped rigidly to the lathe bed. The carriage cross-feed screw is removed. A nest is built to fit around and clamp on the cross-feed casting under the compound and one end of this nest has a hole to fit the stud on the center bracket. When the stud is accurately located under the center of the ball to be turned and the compound swivel screw is loosened, the longitudinal carriage feed will move the tool in a circular arc, the radius of which is easily adjustable by the compound feed-screw.



Free-swivelling compound and free-sliding cross-feed motions are combined and controlled by a pin joint permanently attached to the lathe bed so ball turning can be accomplished with the power feed



Double nut construction enables mandrel expansion to be performed within the shank end of the tool

Expanding Mandrel Tightens In Blind Holes

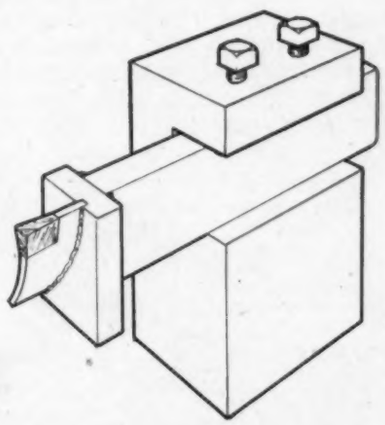
DANA J. MULHOLLAND
Newport, R. I.

Expanding mandrels and arbors for through-bored work or tubing are fairly common but here is a device that will expand and tighten in a blind hole. The tool body is of normal construction except for the transverse rectangular shank slot.

The tightening bolt slips in the end of the split, expanding part and extends well into the open slot where a sawed-off nut fits. The nut is turned slightly larger than the tool diameter at this point, then its sides are cut off so it will slip into the slot. The remaining circular arcs are threaded and the center hole is tapped for the expansion screw. Another nut is made to fit the partial threads of the clamp nut, and knurled and drilled for tightening pins.

Before work is placed on the mandrel the screw is turned in fully without expanding the splits, drawing the inner nut forward in its slot as far as it will go to remove all play. Then the work is installed and the knurled nut is turned, drawing bolt and nut inward as a single unit because the inner nut is unable to turn. The shank can be made to fit any standard spindle.

"Broaching" Phenolic—Some terminal boards required 28 square holes 0.097 in. on a side. Broaching chipped the phenolic so that was out and filing was too expensive. We solved the problem effectively by drilling the holes to diameter then melting the hole square with a special soldering iron whose tip has been machined to size. For speed and accuracy, the iron is mounted in an arbor press. *Joseph Brzczowski, Hackensack, N.J.*



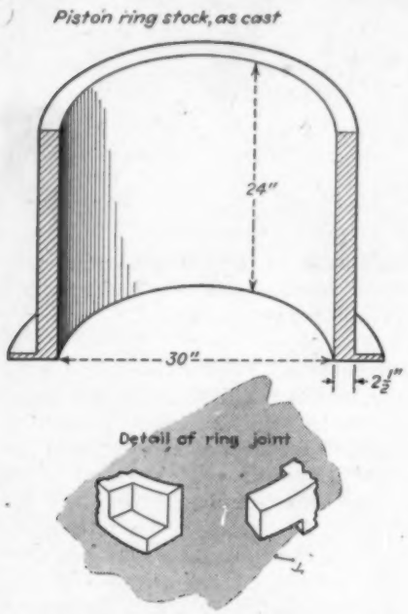
Carbide Lathe Tool—Easily built up from ordinary stock, this tool is very stiff and chatter-free as the curved support piece holds the cutting tip in two directions. *Frank J. Peragine, Brooklyn, N.Y.*

Special Tools Speed Piston Ring Production

F. G. FORQUER
Buffalo, N. Y.

Periodic overhauls of some large gas engines requires new rings made especially to fit the new pistons, and the whole job is pretty much a matching operation, because after boring, the cylinders will be of different sizes and the piston grooves of different widths.

Rings are machined from cast tubing 35 in. in diameter. The first step

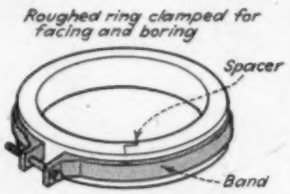


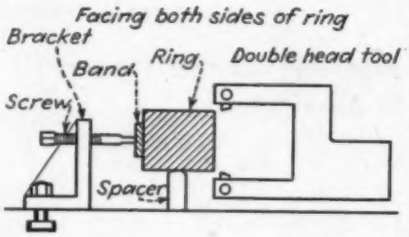
Cast tubing is sliced into rings; joints are milled and hand-filed

is to part off the rings to approximate width, allowing 1/16 in. for fitting the stepped joint. This is done on a 50-in. boring mill using two heads.

Next, the joint is milled in the unstressed position, and filed by hand. Each ring is then pulled together with a steel band, except for a thin shim; the I.D. and both faces are machined without removing the band.

After machining one face on the vertical boring mill then turning the ring over and facing the other side for awhile, we improved the setup by holding the rings on the table in such a way that both sides could be faced simultaneously. Special clamps were made which clamped to the table and dogged the ring horizontally. To get the ring level, it is placed on spacer blocks which are removed after clamping.

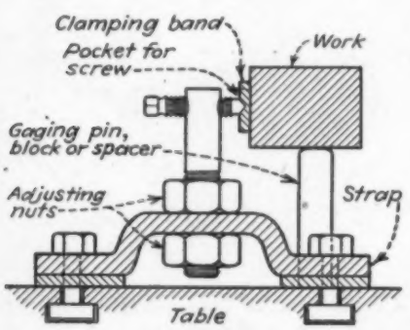




Steel band holds ring closed while one tool faces top and bottom

Facing is done with a double-headed toolholder whose bits are set with a spacer to the desired ring thickness. In this way uniform ring thickness is assured and this wasn't as easy by the old method.

The inside diameter is bored without changing the setup, whereupon the dogs are moved to the inside and the joint securely clamped. The band is then removed, still without actually disturbing the ring and the outside diameter is turned.



Adjustable clamp

Boring mill clamps hold radially while permitting vertical adjustment

Drillpress Attachment Reborés Small Motor End Bells

GEORGE BURNLEY
Oakland, California

It is generally acknowledged that one of the most common troubles encountered in maintaining a group of fractional-horsepower motors under heavy industrial use is due to the slippage and wear of the outer ball bearing races in the motor end bells. As the concave shape characteristic of most standard bells will not permit the average lathe chuck to grip with enough firmness and accuracy to counterbore for a sleeve insert, I designed and manufactured the simple jig shown in the enclosed drawing below to accomplish swift and easy repairs.

To start, I secured a steel plate 12 by 12 by ⅝ inches. A hole was burned out of the center to within ⅛ in. of the inside diameter of the smallest bell and finished to a smooth surface in the lathe. I then counterbored and faced the plate accurately and carefully to receive the bell in precisely the same way it would fit the body of the motor to which it belonged. Without changing the setup I machined on a larger diameter, a similar groove to take a bell of slightly larger proportions. As these two sizes would take care of the majority of the jobs on hand, I then removed the plate from the lathe and laid out and installed studs with wing-nuts to secure each type bell to the jig in a manner identical to the motor body.

Turning again to the lathe, for a boring bar pilot, I took a piece of 11 by 1½ by ¾ in. flat bar stock and chucking it flat against the face plate, I drilled a hole squarely in the center to take a guide bushing. I then machined off the outer ends of the bar for a depth of ⅜ in. to a precision radius of 0.002 in. over the diameter of the hole in the steel plate. Removing the bar, I tapped

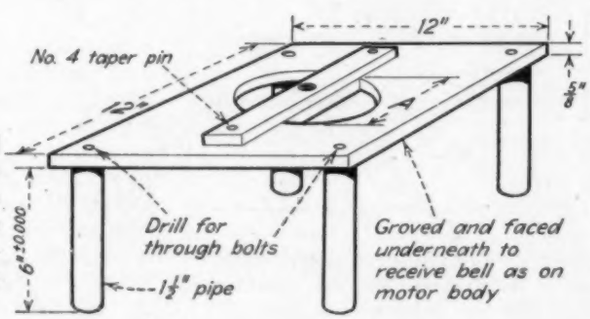


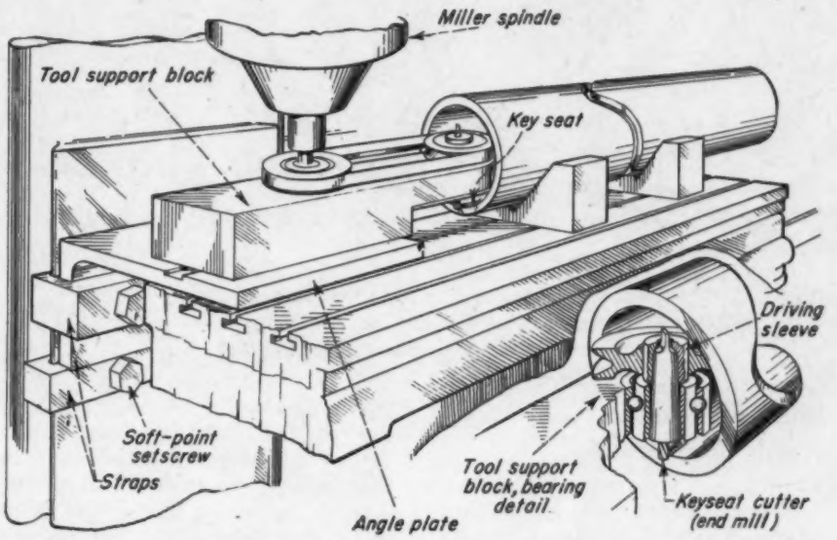
Table holds motor end bells while a pilot attached with taper pins guides the tool for the reboring operation. Dimension A is the minimum motor diameter

the piece snugly home into the flat side of the plate with butt of a machinist's hammer and fitted a #4 taper pin into each overlapping end to assure accurate alignment of this part in the future. Finally, after measuring the hold-down slots of the drillpress which would be used for boring job, I welded a 6-in. piece of heavy pipe, properly faced, to each corner of the plate being sure the alignment would match the drillpress face plate. These "legs" of course, were welded to the machined side of the plate, since the bells would necessarily be held "upside-down" in boring and the apparently excessive length of the "legs" was allowed to permit installation and removal of the bells without disturbing the setting of the jig.

The bell boring job proceeded as follows:—Jig was bolted securely to drillpress. Bell slid under legs of jig and tapped firmly into place on plate and secured by wing nuts to stud. Pilot bar placed across top of jig, pressed home and aligned by taper pins. Drill bushing placed in pilot bar and hole cut in bottom of bell to steady lower end of boring bar. Boring bar lowered through bushing and tool fitted and adjusted to micrometer accuracy over bell.

Tailstock Center Finder—Sometimes small parts are burred or burnished lightly by hand while spinning at high speed between centers. On pointed parts, a female center can be used in the tailstock. This center has to be smaller in diameter than the part in order to dress it full length, but when small, it takes a little longer to find the small indent.

We had to make some blacksmith's bitstock drills, and after milling, the operator would shove the shank into the headstock while the lathe was rotating to save time. The small center, though, was a problem until this self-retracting finder was added. *E. J Hills, Rock Island, Quebec.*



Extension arm, bracketed to column carries a ball bearing spindle driven by a V-belt and pulleys, enabling miller to reach well inside of deep cavities

Lateral Extension Attachment Mills Deep Internal Keyways

C. D. MACKINNON
Airdrie, Scotland

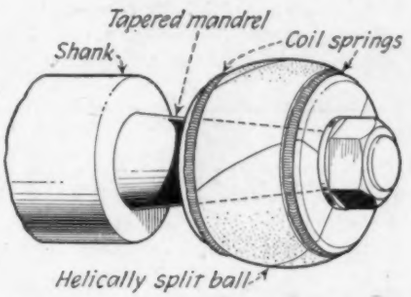
Hundreds of mild steel cylinders required 2½ by ¼ by ⅛-in keyways at each end. The job was executed successfully on a vertical milling machine with the aid of this attachment.

An angle plate and horizontal arm clamped to the machine column carries a ball-bearing spindle tapered to fit standard end mills. The spindle carries a pulley at one end which is aligned with a pulley in the machine spindle and drive is accomplished with a V-belt.

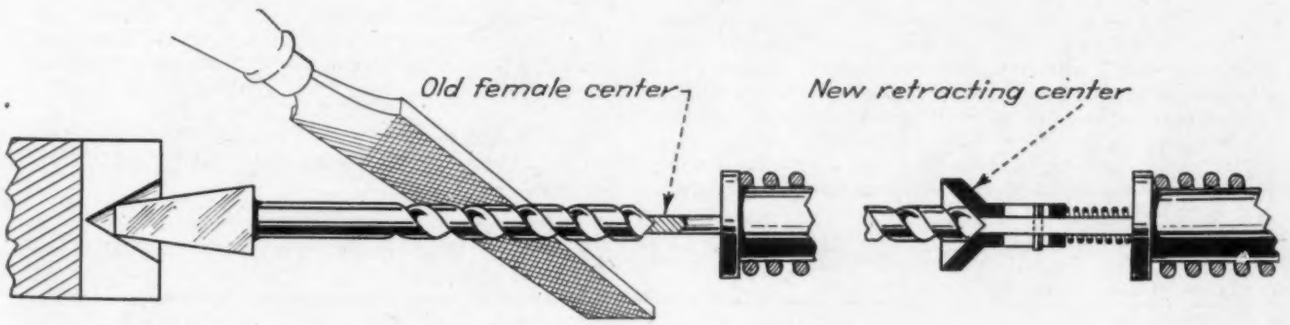
In order not to mar the column, the angle plate is fastened with two dovetail clamps which fit the column closely. The lower clamp is held directly to the column with two soft-point setscrews. The bracket rests downward on this and the other clamp spans both the angle plate and the machine dovetail.

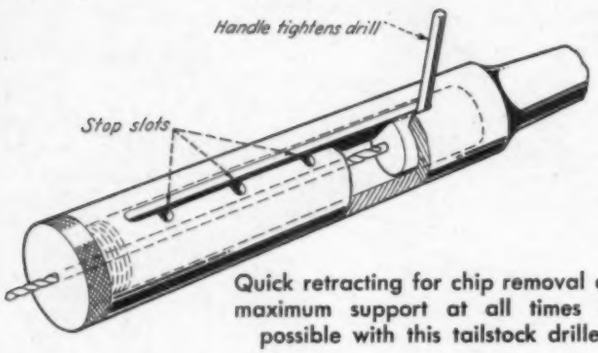
Belt tension is adjusted by sliding the bracket along the angle plate slot before tightening the clamping screws.

The work is mounted on the table in a conventional manner and all feeds are obtained with the table.

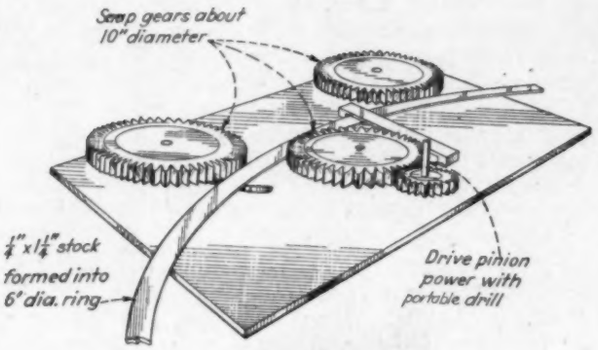


Tube Expander—A split ball mounted on a tapered mandrel makes a faster way to enlarge tubing. We used to drive a solid ball into the work then drive it out from the other end. Now, the ball automatically expands as it enters, and contracts when it's withdrawn. *J. M. Ray, Prattville, Alabama.*





Quick retracting for chip removal and maximum support at all times are possible with this tailstock driller



Lathe Drill Holder Speeds Deep Drilling

H. MOORE
Leeds, England

Drilling small deep holes in an engine lathe is not an economical proposition, but it often has to be done because the hole must be drilled at the same setting as other work.

Drills do not enter very far before the flutes begin to clog. Frequent pulling out and going forward for every short penetration of the drill is not an action particularly suited for a tailstock and I find it better to use an auxiliary holder which not only supports drills better but also affords a rapid means for withdrawing the drill to clear the chips.

This holder fits the tailstock spindle in the ordinary way and is drilled out at the front to take the bushing and the drill holder proper. A long slot is cut in the side of the body and this is divided up into several shallow slots, deep enough to take the handle comfortably. Bushings for several sizes of drills enable the device to be used for general work of this nature.

In operation the drill is advanced by the tailstock spindle in the ordinary way but when it sticks, it is pulled back by lifting the handle out of the slot and pulling it back until the drill is out of the hole. Similarly, a quick repositioning of the drill is accomplished by reversing this operation.

Edge-Bender Forms Heavy Bar Stock

EDWARD S. BARROWS
Philadelphia, Pennsylvania

Devised by the foreman of the tin shop at Baldwin-Southwark, this "machine" forms 6-ft. rings from ¼x1¼-in. bar stock. As this was an edge bend, it could not be handled by any shop roller, hence required 12 man-hr. of hand labor. Now, two men can form a complete ring in 17 minutes.

The sketch is self-explanatory. The adjustable gear is moved in for each successive pass until the desired radius is produced. A #2 Morse taper shank is welded to the 2½-in. drive gear to fit a portable drill.

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Thirtieth Selection—Donald Campbell's Radius Indicator

NEWS OF METALWORKING

Non-ferrous Metal Demand Heavy; Supplies of Lead and Tin May Drop

WASHINGTON — Demand for non-ferrous and light metals remains relatively heavy. Supply of lead and tin is expected to get worse.

Lead, which has been in slightly better supply recently, is expected to lose ground starting in July. The slump will be caused by loss of production in one smelter going down for repairs, and virtual ending of goverhment stockpile increments to the monthly supply picture.

The lead stockpile, which has been contributing 8,000 tons monthly to consumers, will have dried up by July 1. Experts in Washington, however, see indications of a lessening in demand. If this occurs, the production slump will maintain the supply situation close to the present level.

Tin Production Turns Down

Tin production, worldwide, has not lived up to expectations this year. Earlier estimates have been revised downward sharply. For the next 18 months or two years, tin supplies will remain low. The government tin stockpile is running low and present withdrawals indicate it will be exhausted by the end of the year.

The government smelter at Texas City, Texas, has been running at less than capacity recently because of a shortage of concentrates. This will contribute to the stockpile deficiency.

Zinc in Good Supply

Zinc supplies remain close to satisfying demand, with shortages continuing in Special High Grade (dye casting) and Prime Western (galvanized) grades. Demand is weakening somewhat, however.

Fate of the Premium Price Plan for Copper, Lead and Zinc might play a part in the price situation for zinc. If the plan is discontinued by Congress, prices could go up slightly. If the plan continues, prices might drop. A short flurry in market deals for zinc might arise when Congress makes its decision on the plan.

Prices Plague Copper

Copper remains problematical because of a two-price condition existing in the market. Suspension of the 4¢ import excise tax on foreign metal last month is accountable.

With the world price 3¢ or more over the domestic price, and domestic producers fighting to keep their prices at present levels, the situation is trending slowly toward a compromise, which should up the price a few cents. Supply is expected to improve slightly soon, but demand will remain fairly heavy.

Demand for brass mill copper products shows no sign of softening. There has been a slight lessening of order backlog for large-size tube, but small tubing, half-inch and under, is still in short supply. Volume of orders for these products is still in excess of productive capacity. Brass prices are going up, the extent depending on what happens to copper prices.

Aluminum Draws Attention

Aluminum has been spotlighted by announced intentions of several producers to reduce production. This was caused by a sudden glut of aluminum building materials—roofing, window frames, etc.

Sheet, tube, wire, and some special shapes will remain in short supply for the rest of the year. Orders remain heavy for products other than housing materials. No price change is visualized at the present time.

Magnesium supply is bountiful. Production capacity by the one producer is greater than demand.

Chicago Metalworking Officials Say Orders Belie Recession Talk

CHICAGO—Despite recession talk, Chicago area metalworking executives report production is continuing at high levels, sales are holding up, and unemployment is not in evidence.

▸ Hotpoint, Inc., officials are looking for more help. The firm plans to treble facilities for producing electric appliances for cooking and water heating. John J. Nance, president, says that while Chicago's labor market is tight, it has a pool of the "most widely varied, skilled potential employee of any city in the country."

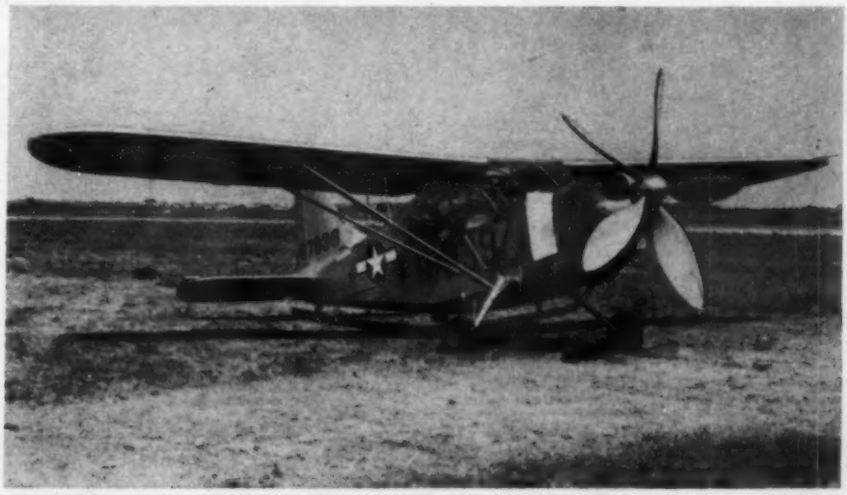
Increased Output, Employment

▸ The Pressed Steel Car Co., manufacturer of electric ranges, plans to increase output from 40,000 to 100,000 units a year. Additional help will be required.

▸ Stewart-Warner Corp. has had a slight falling off in certain departments, which led to some interdepartmental shifts of employees. But on the whole, the company reports its employment continues to climb.

▸ Borg-Warner Corp. officials say there has been no recession in business, and output continues on a high level.

▸ Both International Harvester and United States Steel are also seeking additional employees of all types in this area.



NACA Reduces Private Plane Noise—Following complaints on excessive noise from private planes, National Advisory Committee for Aeronautics modified this Stinson L-5 with a five blade, low-speed "fan" propeller and an engine exhaust muffler. This reduces noise pressure by more than 90%

Gaging Business

Production Pace Continues

Metalworking operations show few signs of slackening. The only brake upon still higher production in several metalworking industries —automobiles, farm implements, refrigerators, railroad cars—is the inability to get a sufficient supply of steel. Many metalworking lines promise to hold at current levels throughout all of 1947, despite receding business in soft-goods industries.

Nevertheless, the inflow of fresh orders in numerous metal goods is not so copious as it was a few months ago. Manufacturers are paring down their backlogs, however, as they strain to keep output at a peak. Here and there evidences are at hand that activities are tapering, such as in machine tools, plastic machinery and radios.

Machine Tool Demand Spotty

Machine tool sales continue spotty. Business booked the last week in May was abnormally large in the case of certain prominent builders who announced price advances up to 10% effective June 1. Many manufacturers, however, are holding off decisions regarding prices until they discern more clearly the industrial trend. Builders who have raised prices point to the fact that they have absorbed in large degree the rise in wage rates which have doubled since 1939 and did not take full advantage of the increases permitted by OPA a year ago.

Automotive Tool Buying Expected

Prospects are good for a pick-up in demand for the automotive industry, normally the machine tool industry's biggest customer, the latter half of this year. Ford, for one, is spending $70 million for new machine tools during 1947. General Motors divisions expect to make outlays running into the millions for machine tools later this year. General Motors, since the war's end, has gone through with a modernization and replacement program involving purchase of 30 000 machine tools, of which roughly 11,000 were surplus government units.

Pratt & Whitney Aircraft is reported placing orders for a tooling program for manufacture of jet engines. Export sales have been less than anticipated, mostly because of the dollar famine abroad. Many more U. S. machines could have been sold at the Paris Fair if European customers could have secured the necessary import licenses.

Tool and Die Business Off

Tool and die manufacturers have not yet had a break in the declining trend of their business which began late in 1946. Backlogs and employment continue to be whittled down each month, though the volume of work turned out thus far this year compares favorably with last year. Most shops are operating only one shift; here and there a company is on two shifts. The absence of automotive tooling programs has had a blighting effect upon tool and die shops in the Detroit area. A pick-up is looked for, however, later in the year. The average backlog in the industry is about two months. Outlook is only fair at best for the near term.

Cutting Tool Demand Active

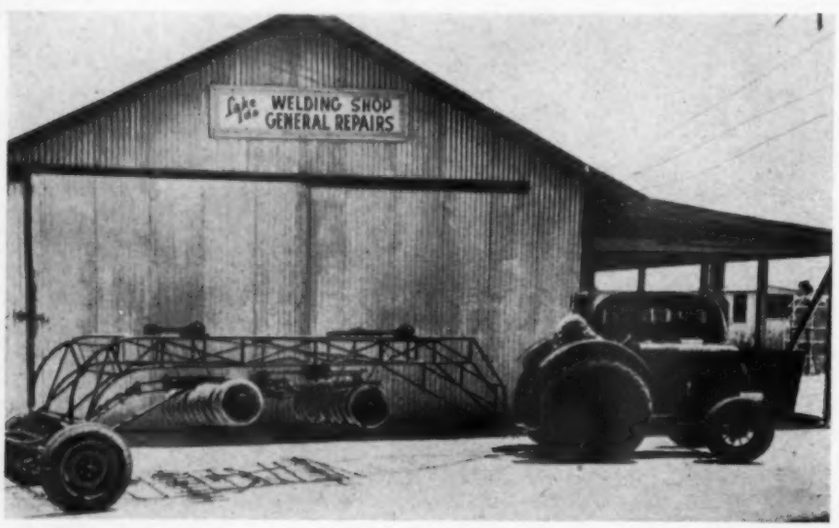
Cutting tool business has been maintained at a production pace higher than in 1946. In the early part of last year strikes interfered with metalworking shop operations, whereas this year almost full output has been achieved in many lines, with a subsequent demand for cutting tools. The volume of business now on the books should keep production at or near current levels during the remainder of the year. Orders for taps and reamers are reasonably brisk. Twist drill sales are holding fairly well. A considerable portion of cutting tools is being exported. Foreign demand is aided because Britain's cutting tool industry is not able to supply as large a portion of overseas requirements as it normally does.

Office Machine Sales Brisk

Makers of office machines—typewriters, adding machines, other computation machines—report an encouraging backlog of orders. In at least two cases, the pile-up of business is the largest on record, and today is greater than it was a year ago. In fact, some companies say that their bookings at present exceed those at the beginning of the year, despite record peacetime output. One manufacturer states that its backlog has increased every month for the last 43 months.

Refrigerator Output High

While radio manufacturing is back to its prewar competitive position, electric refrigerator makers still have an extraordinarily busy period ahead. Production this year will reach 3,400,000 to 3,600,000 units, compared with 2,000,000 units in 1946. Shortage of sheet steel continues to be the worst deterrent to production. The supply of motors and compressors, for instance, is far ahead of steel. Washing machine output stays relatively satisfactory, though here and there signs are appearing that a slackening is not far off. Makers have had trouble, incidentally in securing steel for washing machine tubs. Vacuum cleaner and electric range manufacturers are trying to keep assemblies as high as materials available and factory capacity will permit. Electric lamp production is at an all-time high. Turbine makers are as busy as ever, with deliveries running into 1950.



All Welded Farm Carryall—Designed to transport choppers, disc plows and similar machinery around the farm, this all welded Carryall was recently announced by the Lake Ida Welding Shop, Winter Haven, Fla. The unit is 15 ft. 4 in. long, 52 in. wide, 49 in. high and weighs 600 lb.

Steel Supply for Freight Cars Improves; Other Users Affected

PITTSBURGH—Steel demand is so strong over a wide assortment of products that appearance of a few easy spots is being shrugged off by the industry.

Stainless and other alloy products, cold-drawn bars and large carbon rounds are more readily available. There remains need for heavy tonnages of sheets and strip, and some heavier items to meet production demand and inventory balance.

Ingot production for the first half of 1947 will probably establish a new peacetime record. Nevertheless, steel executives still believe supply and balance in most industry products will not avail until the end of 1947.

Railroad Supply Improves

Auto makers' complaints of insufficient cold-rolled steel support contentions inventory pipe lines have yet to be filled. On the other hand, such pipe lines in the railroad equipment industry give promise of being filled this month.

Freight car makers say they should now have a parts balance to meet their June schedules after a disappointing May. Shipments of steel to them in March, April and May were of sufficient abundance to create optimism on outlook for freight car production during the second half of the year.

This situation, however, is drawing heavily on available production of plates and small shapes, so other consumers of these items are dissatisfied.

Sheets Remain Critical

Nails are in better supply. Not much progress is being made in meeting demand for standard pipe and large diameter pipe.

Except for large diameter tubing, sheets will take the longest period to meet demand. New manufacturing facilities in sheets will not be fully completed until 1948. The auto industry's need for cold-rolled sheets will probably be met by the fourth quarter.

Increasing production of tin plate is preventing increased diversion of hot-rolled coils to automobile use.

Prices a Dead Issue

The matter of prices, temporarily at least, is a dead issue in steel. Industry spokesmen hope it stays that way until second and third quarter earning reports are analyzed. They expect statements to be less favorable than those of the first quarter.

Reports of pending readjustment in exports, which may spring from a shortage of foreign exchange, are viewed without misgiving by the industry. The export market is expected to take all the steel it can get for months to come.

40 Speakers Address SAE Members At 5-Day Session in French Lick

FRENCH LICK, IND.—Engineering advancements, research results, and potential trends in the automotive industry were discussed by nearly 40 speakers at the second postwar summer meeting of the Society of Automotive Engineers held here the early part of this month.

At opening sessions of the five-day meeting, Julius Caussoin of Silver Eagle Co., urged improvements in air-brake design for commercial truck-trailer combinations. He recommended installation of larger relay-emergency valves, of one relay-emergency valve for each pair of brake chambers, of short-throw large-size foot valves, and a close range between minimum and maximum air-governor settings.

Tomorrow's Car Visualized

Discounting so-called "dream cars," Virgil M. Exner of The Studebaker Corp., predicted tomorrow's car will borrow from aircraft design by eliminating projections and structural abruptness to reduce wind resistance; will incorporate lower bodies and greater visibility.

Kenneth A. Hopkins of the George W. Walker Organization, visualized tomorrow's car as being better proportioned; lower for safety at high speeds; incorporating aircraft characteristics, and using lighter, stronger engines.

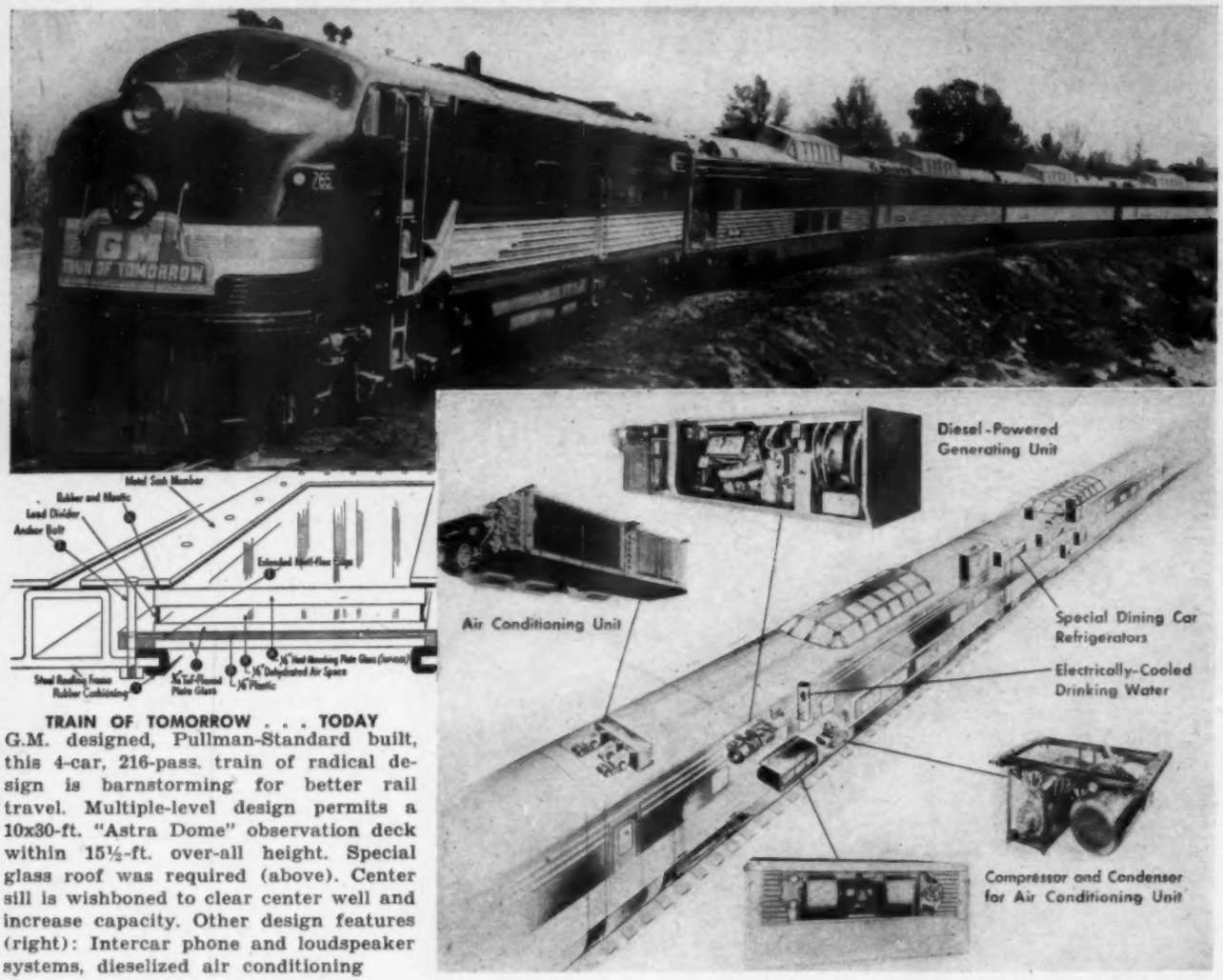
Design and development along radical lines of a reinforced plastic car were described by Louis A. Werner, engineering consultant. He said the chassis-less vehicle is suspended on air bellows fed from an expansion tank which controls ride softness and maintains constant road clearance.

Edmund B. Neil, consulting engineer, said modern materials and design principles make possible development of steam, or vapor, engines for motor trucks and buses. He indicated that shortcomings of early "steam automobiles" have been corrected through high-strength cast irons and alloy steels, etc.

Cooperative Research Proposed

C. F. Kettering, who retired recently as General Motors vice president in charge of research, proposed a long-range program of cooperative research and engineering between the petroleum and automotive industries. He said it would lead to greater fuel economy in motor vehicle operation with a resultant saving in petroleum reserves. He envisaged auto transportation being reduced one-third in cost. He warned that a jump from present engine to high-compression types can only be taken in steps.

Three Parts Brazed Simultaneously—Lawn mower rotors are being joined by Reading Hardware Co., Reading, Pa., in fast time with alignment between the parts held to close tolerances. The outstanding feature of this operation is the joining of three steel parts — a spider, drive shaft, and bearing retainer — in one operation. Four assemblies are brazed at one time in a total of 30 sec. With two brazing stations, 3,840 units can be produced in an 8-hr. day



TRAIN OF TOMORROW . . . TODAY
G.M. designed, Pullman-Standard built, this 4-car, 216-pass. train of radical design is barnstorming for better rail travel. Multiple-level design permits a 10x30-ft. "Astra Dome" observation deck within 15½-ft. over-all height. Special glass roof was required (above). Center sill is wishboned to clear center well and increase capacity. Other design features (right): Intercar phone and loudspeaker systems, dieselized air conditioning

Kure Beach Corrosion Tests Expand; French Steels Among 20,000 Samples

WILMINGTON, N. C.—With about 20,000 specimens under test, the corrosion testing project at nearby Kure Beach is being broadened constantly.

Started because F. L. LaQue of The International Nickel Co., wanted to see how nickel steel would stand up in sea water, the project has grown into an outstanding example of industry cooperation—with specimens from hundreds of firms.

Test racks and other equipment were set up and are maintained by International Nickel, Dow Chemical Co., and Carnegie-Illinois Steel Corp.

Tests undertaken early this month include a group of French steels, having coated and passivated surfaces, which will be compared with U. S. steels.

Tests on Iron, Steel

Results of tests on many compositions of open hearth iron and steel, and Bessemer steel indicate copper is most effective in open hearth irons from 0.004 to 0.02%; up to 0.05% produces some improvement. Larger amounts are effective in combination with nickel.

Phosphorus has a fairly good effect, especially when copper content is low; manganese is slightly beneficial. No conclusive data were obtained with silicon, but there are indications that with nickel and copper it may have a favorable effect.

Nickel is uniformly beneficial, roughly in proportion to content, up to 5%. This is true whether used alone or in combination with other elements. Chromium is beneficial in direct proportion to content with weight loss negligible above 13%.

There is close correlation between the color of rust and weight loss from corrosion. Lighter reds and yellow indicate rapid weight loss; darker reds indicate less loss with an almost black rust being most desirable. Corrosion loss over a long period may be predicted from the color of rust in early stages of exposure.

Heavier Plating Warranted

Tests of various automotive bumper finishes show that most methods in use both before and during the war break down in a few weeks. Best results have been obtained with a base of 0.002-in. nickel. Good results have also been obtained with combinations of copper and nickel. As a result, most auto manufacturers are now using heavier plate.

Tests of proprietary steel show relatively small variation in resistance to corrosion and indicate the choice among them should be made on other factors.

Magnesium alloys of many types are under test with plain and treated surfaces and various fabricated structures included. They exhibit exceptional resistance to salt atmosphere.

Detroit

100,000 CARS A MONTH IS OUTLOOK . . . PART PRODUCTION FINALLY TAPERS . . . SURVEY SHOWS AUTO USERS DEMAND ADDED VISIBILITY

June Auto Revival

Automobile production revived in early June after the May slump caused by shortages of steel sheet in many producer plants. Volume rose to the earlier levels, around 100,000 cars and trucks a week.

Labor troubles may serve to reduce this total modestly in the period immediately ahead. The CIO United Auto Workers Union is becoming more militant in its 15¢ wage raise demand. Smaller companies, mainly the makers of parts and accessories, know they cannot meet this call and absorb it, so they are resisting. These two positions may result in walkouts which will hold up final assemblies in the car and truck plants.

While a possible sag is thus indicated, nothing in the near term horizon promises any expansion of note. Sheet steel continues on a hand-to-mouth basis, and if it were readily available, shortages of castings and copper would create other bottlenecks quickly. The outlook, therefore, is for sustained production somewhere near the 100,000-mark for a few months ahead.

4th Quarter Rise Possible

The projections for output during the rest of this year are firm, but hardly buoyant. Nobody expects now that the third quarter will see any manufacturing volume beyond that of the first two quarters, and the only hopes are that enough added steel will be available during the fourth quarter to give a final fillip to '47.

Indicative of the realistic state of thinking was a June report from Briggs Mfg. Co. which pointed out that even though the company is tooled to handle approximately 465,000 tons of steel, it will process only around 295,000 tons this year. Last year's handling came to about 195,000 tons, though, so gains are being registered.

If the entire industry enlarges its volume in the same 1946-47 proportion of Briggs, incidentally, output would gain from last year's 3,268,456 cars and trucks to just under 5 million—which is the general median line of most forecasts today.

One other interesting fact was brought out in the Briggs figures. In 1946, it was made known, the company had floor space of 6,725,000 sq. ft., representing an investment of $62 million. In 1937 floor space of 4,165,000 sq. ft. involved an investment of $38 million. The 1937 investment aggregated $9.12 per sq. ft.; today's $9.23. When it is considered that these figures undoubtedly give effect to writedowns of the large share of the company's facilities built in the past, the comparatively high costs of today's construction and tooling are indicated aptly.

Time and Cost Saver—Incoming wire at United Steel and Wire plant, Battle Creek, Mich., is transferred directly to monorail for transporting to the wire straightening machine by this Clark Carloader type fork truck. 100,000 lb. of coiled steel wire is unloaded and handled every 1¾ hr. by this method

Parts Ordering Slows

Part production, a child of good fortune for the past six years, is finally tapering. An almost imperceptible slowdown in ordering by retailers began late last fall, and continued through the winter. Only in recent weeks has it become clear that this curtailment was somewhat more than the normal seasonal line. In April ordering rose modestly, but, again, not as much as seasonal normal.

The lag in parts buying traces back to very simple causes. More new cars are on the road, reducing over-all requirements for replacement parts. More owners of old cars are nearer the day when they will take delivery of new ones, and they are more apt to let their old cars drift along as are, rather than fix them up. Finally, jobbers ordered and over-ordered during the past few years as availability of inventory became more than a dream; and they are overstocked today.

Customers Wants Surveyed

Long-range thinking on car design is fairly evident these days. As for bodies, for example, virtually all automobile companies are making surveys of one sort or another to uncover what the customer wants. They largely find he seeks, first, greater visibility, and, second, wider seats.

That means more glass will be seen in the 1948 cars, and still more in the ones to follow. It means a hood which will get shorter gradually over the years, so the driver can get a closer glimpse of the road.

Hydraulic Power Discounted

Those who have been anticipating hydraulic primary power for automobiles were doused with cold water at a recent Detroit meeting of the Society of Automotive Engineers. The douser was M. A. Hayden, of Vickers, Inc.—leading factor in the machine tool hydraulics field.

Answering a question on possible applicability of hydraulics in the auto field, Hayden pointed out that as long as customers want cars with power in low ranges and substantial high speed, the only qualifying hydraulic applications he knew of would be of size and complexity well beyond the range of passenger car installation.

More feasible, he indicated, were hydraulic power packages for agricultural implements—small fully-contained units which stop, start and control speeds of implements.

Advances in Power Metallurgy Cited by Speakers at Meeting

NEW YORK — Ferrous powder metallurgy is winning broader commercial applications and continued research will lead to increased uses. These points were made recently by speakers at the third annual spring meeting of the Metal Powder Association at the Waldorf-Astoria Hotel.

Charles Dale, president, Charles Hardy, Inc., cited acid-resistant stainless steel filters as among the first successful applications of chrome-nickel powder. He reviewed how this powder permits adequate bonding of non-stainless surfaces and stainless steel coating.

E. E. Ensign, of Ford Motor Co., told of his company's success in developing lower cost tooling for fabrication of powdered metal parts. He explained a restriking stage in which an extrusion plate facilitates sizing and prevents eccentricity and rapid tool wear.

Dr. Henry H. Hausner, consulting engineer and research associate, New York University, presented an exhaustive analysis of cost calculation in production of powdered metal parts. He said manufacturers of compacted metal parts must spend considerable money for research, including development of new applications, new products, improved quality, and reduced production costs.

E. R. Darby, of Federal-Mogul Corp., revealed that reduced production costs warrant use of continuous-strip method in making steel-back, copper-lead bearings. He said problems of gassing and lead segregation have been eliminated.

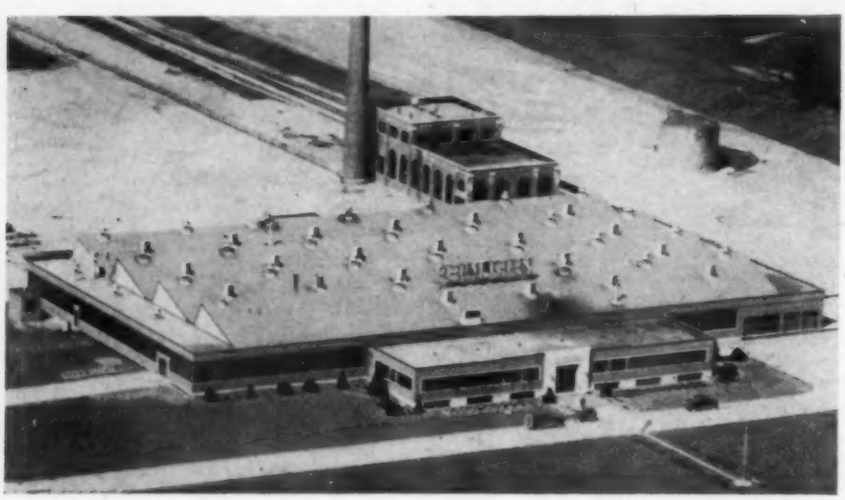
Other speakers at the day-long session were: H. E. Hall, association president; E. C. Truesdale, New Jersey Zinc Co.; A. J. Langhammer, Amplex Div., Chrysler Corp.; E. I. Shobert II, Stackpole Carbon Co.; Ernest Scheller, Metals Powder, Inc.; and P. E. Weingart, chairman, association's Board of Directors.

Standards Seminar Opens In New York Next Week

NEW YORK—A five-day seminar on organization and techniques of industrial standardization will be conducted by Dr. John Gaillard, mechanical engineer, American Standards Association, at the Engineering Societies Bldg., 29 West 39th St., N. Y., from June 23-27 inclusive. Ten morning and afternoon lectures, supplemented by round-table discussions, will cover such subjects as: (1) various types of managerial and technical standards, (2) the progressive-time curve in development of a product, (3) limit systems applied to cylindrical fits, (4) gaging specifications, and (5) organization and development of standardization work in a manufacturing concern.

Rudel-Carey and Briggs Combine

NEW YORK — Rudel, Carey & Briggs, Inc., has been formed as of June 1 by consolidation of Rudel-Carey, Inc., and Walter D. Briggs, Inc. Both firms have been operating in the fields of high-speed and carbide cutting tools, abrasives and machine tool accessories in this area. Office and warehouse of the new company are located at the former headquarters of Rudel-Carey, Inc., 435 Fourth Avenue. Comprehensive stocks are maintained for immediate service to customers.



New Timken Branch Plant—Opened recently at St. Thomas, Ontario, this plant will make commercial sizes of Timken roller bearings for the Canadian market. Present plans call for gradual enlargement with facilities for making and heat-treating races and rolls to be added as production requirements warrant

Stevens Institute Awards Medal To L. H. Bailey at Ceremonies

HOBOKEN, N. J.—Basic problems to be met in building intricate presses to handle powdered metals involve securing proper density and density distribution, and required accuracy in parts produced, according to Lawrence H. Bailey, chief engineer of F. J. Stokes Machine Company, Philadelphia.

Mr. Bailey, who has had a vital part in development of presses for powdered metals, was awarded the medal presented annually by the President and Trustees of Stevens Institute of Technology. He made the medal lecture sponsored by the Institute's Powder Metallurgy Laboratory on June 4.

"The present demand," he said, "is for still larger presses with more punches and more complicated motions, so more complicated pieces can be made."

He described one of the latest and most complex presses—a single-station can press known as the "244." It applies 85 tons total pressure from above and below, has two independent upper punches and three lower punches, and transfers loose and partly compressed powder from the original filling levels to higher and lower compressing levels.

Mr. Bailey believes that in addition to problems of machine design and construction for powdered metal manufacturing, press manufacturers should, when required, contribute capable engineering services in the design of dies to assure satisfactory operation of their equipment.

Burt Sees Opportunities Ahead Despite Present Thin Profits

SPRINGFIELD, MASS. — Citing economy in government expenditures and tax reduction as "musts," Clayton R. Burt, board chairman, Niles-Bement-Pond Company, believes bright opportunities lie ahead despite present narrow profit margins.

Speaking at the 3rd annual New England Conference, held under auspices of the National Tool & Die Manufacturers Association, Mr. Burt said the Administration's backing of wage increases forced costs to unreasonable levels while profit margins grow thinner. Production must increase and cost come down, he warned the 350 shop owners and guests attending.

The speaker said "Now is the time to take some chances and try for the future, dim though the immediate outlook may be." He asserted machine tools are the backbone of production, but would be useless if there were no tools and dies available.

Labor Relations, Cost Reductions Highlight Annual Meeting of AGMA

AGMA President | **Vice President** | **Treasurer**

Raymond B. Tripp
Exec. V.P., Ohio Forge & Machine

Walter L. Schneider
V.P., Falk Corp.

Fred W. Walker
V.P., Phila. Gear Works

HOT SPRINGS, VA. — Record attendance of almost 300 members and guests marked the 31st annual meeting of the American Gear Manufacturers Association at The Homestead, June 2-4. In conformance with recent practice, time was divided about evenly between general sessions and committee meetings.

The society has expanded its statistical department to permit more extensive surveys of costs, production and other elements, having added D. J. MacCartney, statistician.

George Hodge, asst. vice president of International Harvester, discussed labor relations, speaking from the point of view of a company with some 80,000 employees and 190 unions. He emphasized particularly that the general public is growing to expect management and labor to get along, and that mutual confidence is the only sound basis for operating.

Philip M. McKenna, president of Kennametals Company, described uses of cemented carbides. Interesting was the fact that in machining a particular ring gear, cost of the carbide tool dropped from $24 in 1940 to $6.66 in 1941, and to $4.45 in 1947. He also suggested use of carbide for small pinions and worms where loadings are excessive or abrasive materials are encountered.

H. J. Inch, Jr., of Ford Motor Co., presented a paper on reducing costs in manufacturing transmission gears. He advocated five steps in cost reduction: Utilize material to better advantage, produce uniform forged structure, simplify locating points, eliminate secondary handling, and provide satisfactory quality control. He pointed out that hot-pierced bores in gears could be broached, saving 25% in material and as much as 50% of time by redesigning for mass production.

At the Commercial Forum, several definite points of broad interest were made, among them the fact that cash discounts are a poor device.

ELECTED TO AGMA EXECUTIVE COMMITTEE

J. E. Mullen
Sales V.P. Nat'l. Erie

Leroy Brooks, Jr.
Pres., Tool Steel Gear & Pinion

Bradford Foote, Jr.
V.P. Brad Foote Gear

Roger B. Salinger
Pres. Mass. Gear & Tool

Speakers Describe Advantages Of Statistical Quality Control

CHICAGO—Increased recognition of the importance of statistical analysis as a management tool was shown by attendance of more than 1,000 industrial executives and analysts at the second Mid-west Quality Control Conference here, June 5-6.

Held simultaneously with the first annual convention of the American Society for Quality Control, the conference featured 35 clinic meetings on various aspects of applying statistical control methods to industry, including use of the methods in inspection, time study, process control, and personnel departments.

A. B. Howard, works manager, W. A. Sheaffer Pen Co., said management's quality objectives cannot be achieved merely by instituting a quality control program. He pointed out it must be integrated with close cooperation between engineering, production, inspection, persons on the job, and the quality control analyst.

Mr. Howard listed four principal objectives:

- 1. A change from negative to positive inspection. In the latter, inspectors show supervisors and operators where they are deviating from the desired level of performance and when to adjust the process or grind the tool.
- 2. A change in quality consciousness, with workers "showing off" their ability to produce good work. Attitude of supervisors and employees must be "Now it must be better."
- 3. Keeping supervisors, department managers and manufacturing executives informed of relative quality position constantly, so necessary corrective action can be taken.
- 4. Keeping supervisors and management informed regarding exact working limits possible on various production machines.

Dr. Walter A. Shewhart, technical staff, Bell Telephone Laboratories, who "invented" statistical quality control two decades ago, has been elected the first honorary member of the society. He was presented with an engraved scroll by George D. Edwards, ASQC president, and director of quality assurance, Bell Telephone Lab.

George F. Smith, president, Johnson and Johnson, described experiences of his firm in establishing quality control by statistical analysis. He outlined benefits, tangible and intangible, from its use. He predicted that in the near future many companies will request from vendors documentary proof of quality of goods purchased. He believes statistical control methods are the answer.

Maritime, Coal and Railroads Loom As Major Threat to '47 Labor Peace

NEW YORK—Two important labor questions confront management today: (1) Will Congressional action on labor legislation contribute to labor-management peace, or lead to new, deep disturbances? (2) When the records are in, will 1947 be a good strike year, or a bad one?

The first is clouded by intangibles. Accurate assessment of Capitol Hill developments cannot come until they take a concrete, well-defined form.

It is difficult for management now to look ahead clearly for the answer to the second question. Currently, the outlook is good.

Three broad barriers to industry-wide labor peace loom. Major nationwide tieups still can come in the maritime industry, bituminous coal fields, and on the nation's railroads.

In the first two, union-management relations have been on an up-and-down scale — progress and friendly bargaining have been followed by discouraging impasses. Negotiations are just getting underway on the railroads, and no showdown is likely until November at the earliest.

Settlements have spread through most major production units of automotive, steel, electrical manufacturing, rubber, textile, glass, metalworking, and other key industries. Walkouts will come in all of them, but they won't disturb national production and distribution on a dangerous scale.

Principally, walkouts will result from inability of small employers—steel fabricators and auto parts makers for example—to meet contract terms set by top producers.

There is evidence of a growing firmness by management against panic buying of labor peace at any price set by labor. Notable is Ford Motor Company's answer to United Auto Workers (CIO) contract demands recently.

Ford offered the pattern 15¢ overall hourly increase, but attached strings to any agreement. The strings sum up to a free hand in tightening up lax plant practices; obtain more assembly-line efficiency, and better productivity.

Other instances of firmer attitude by management have led to labor militancy. Result has been a rash of strike threats with more in the offing. These will cause dislocations, but no disruptions. Hence they may be minimized by all except those in management directly involved.

Labor Bill Would Void Decisions Involving Foremen, Plant Guards

WASHINGTON—At least two recent U. S. Supreme Court decisions important to management would be nullified by the Taft-Hartley labor bill.

• 1. In the Packard Motor Car case, the court upheld the right of foremen to bargain collectively.

• 2. Ruling against E. C. Atkins & Co., and Jones & Laughlin Corp., it said plant guards were free to join a union, even if it was the same union to which production workers belonged.

While not prohibiting foremen or other supervisors to join unions, the Taft-Hartley bill distinctly states "no employer shall be compelled to bargain with his supervisors." In other words, foremen will be on their own and free to get what they can, but without government backing.

The bill's definition of "supervisor" is broad enough to include persons who, in any way, direct activities of others, so long as such direction requires use of independent judgment.

Plant Guards Restricted

As to plant guards, the bill would bar the National Labor Relations Board from certifying a bargaining unit which mixed guards with other employees.

Also, NLRB could not certify a union as bargaining agent for guards if the union accepted non-guards as members or was affiliated with an organization which did, such as CIO or AFL. Guards' unions would have to remain strictly independent of any non-guard union.

Senate-House conferees omitted several stiff provisions which were in the original House bill, including the ban on industrywide bargaining.

Separate Negotiations Omitted

Also left out was any provision for preventing unions like the CIO Steelworkers from insisting that all of its local unions make the same settlement with fabricators and other employers as that made in the basic steel industry.

Sen. Irving M. Ives has urged the steel union to recognize voluntarily the right of non-basic steel firms to negotiate in the light of their own situation and not have the U. S. Steel settlement, for instance, imposed upon them arbitrarily. This has been a burning question.

80 Passenger Stratocruisers Near Completion—First of the new 340 mph. Stratocruisers for use by six domestic and foreign airlines are nearing completion on the final assembly floor at Boeing Aircraft Co., Seattle. Workmen are making final installations on the double-deck liner's foldable vertical tail here. A completed Stratofreighter and sections of the new Boeing B-50 superbombers are in the background

International Bank Loans Sought For Machinery, Production Items

WASHINGTON—Nine foreign governments have applied for slices of the ¾ billion U. S. dollars in the International Bank's loan till. They want to buy machinery, other production equipment, and materials for rehabilitation of their agriculture, industry, transportation and utilities.

The French loan has just been granted and others are under consideration. Applicants want U. S. money mainly because this country is chief producer of what they need —and because most other currencies lack stability.

Pending applications (all for U. S. money) are totaled by John J. McCloy, president of the International Bank for Reconstruction Development, at $2,310 million. Requests will be cut on the average to 1/3 the asking figure.

French Request Trimmed

France was trimmed only 50% to $250 million because it represents a keystone in recovery of Europe. Self-support for Europe is the bank's main objective.

Authorized capitalization is $10 billion, of which $8 billion have been subscribed. To date, 20% of subscriptions have been called for payment. The 80% balance is held in emergency reserve.

Officials say the International Bank should not be regarded as a U. S. institution, a mistake made by many. Mr. McCloy's staff, under loan agreements, will scan use of all borrowed funds.

Borrowers are free to buy anywhere. Some of the money will undoubtedly be spent in European markets for machine tools, locomotives, autos, light machinery and instruments because of slow deliveries from the U. S.

Applications by Countries

Here's the lineup at the credit window:

Chile: Wants $40 million for electric power, forest industries, rail electrification, port mechanization.

Czechoslovakia: Seeks $350 million for industry, agriculture, construction, transportation.

Denmark: Asks $50 million for industry and agriculture.

France: Sought $500 million, allowed $250 million for modernization of steel industry, including a strip mill, locomotives and freight cars, cargo ships and barges, commercial airplanes, coal and oil, semi-finished steel products, and nonferrous metals and other materials.

Iran: Wants $250 million for industry, agriculture, transport—over 5 to 7 years.

Luxembourg: Asks $20 million for general rehabilitation of war damage.

Mexico: Seeks $209 million for irrigation, hydroelectric, highways, railroads, harbors. This is additional to U. S. $50 million loan.

Netherlands: Wants $535 million; formal application not filed yet.

Poland: Requests $600 million to finance the government's 4-year reconstruction and development plan.

Treasury Explains Opposition To Depreciation Adjustments

WASHINGTON—The Treasury will not permit adjusted depreciation of plant and facilities, acquired at prewar prices, to offset replacement costs approximately 50% higher. There will be no departure from the Internal Revenue Code definition that for tax purposes, the basis of property value is its cost.

Even if no code existed, Treasury's position is that calculation of varying dollar values, in losses or gains, would involve prohibitive effort and confused results.

Discrimination Charged

Such treatment accorded the production industries, Treasury argues, would be discriminatory. It would have to be carried clear across the economy board.

Some industry authorities, disagreeing with those who ask for adjustments, fear that concessions now for high prices might work in reverse against industry in a declining price trend later on.

Machine tool and other industries, some of whose spokesmen have been calling for adjusted depreciation for tax purposes, must look to Congress for relief.

Hearings now in progress look toward an over-all tax structure revision next year. The House Ways and Means Committee is being told forcefully that accelerated depreciation would lower production costs, encourage modernization.

Meanwhile some firms are creating reserves against depreciation of facilities, bought at prewar prices, which will cost much more to replace. Among them are du Pont and U. S. Steel. Republic Steel is reported to have discussed such a reserve, and dropped it.

WAA RECORDS BLANK ON MACHINE TOOL GIFTS

WASHINGTON—Machine tools-for-schools program has no reports of disposals as yet, and may never have. WAA cites lack of bookkeeping help. Next giveaway drive by WAA will be electronics surpluses. Paper work is nearly ready. There'll be donations in other lines, but WAA is keeping mum. It is hoped acceptances will be greater than requests from schools.

Railway Gun Scrapped—One of the factors contributing to the slightly improved scrap situation is the continued scrapping of obsolete war equipment. Here a partly dismantled 14-in. Army railway rifle is being cut for scrap. The gun weighs 375 tons and was 60 ft. long

Machine Tool Survey Shows Slump in Worker Productivity

Trends in unit man-hour requirements for the machine tool industry are highlighted here from an exhaustive study prepared by the Bureau of Labor Statistics and covering the years 1939-1945. Fourteen general-purpose machine tools were made the basis of the survey

BY JOSEPH M. GAMBATESE, WASHINGTON LABOR EDITOR

WASHINGTON—The man-hours of work required to produce a single machine tool dropped, on the average, about 10% between 1939 and 1941, the period of mobilization for war.

During the first two years of war, there was little change: the man-hours required continued at the same lower level.

But during the last two war years, efficiency slumped to the extent that the entire saving in man-hours of the first two years was more than completely wiped out.

By 1945, the number of man-hours needed to make the same machine tool was nearly 4% above 1939.

This is the general—the average—picture of productivity in machine tool production (chart below) disclosed by a special study just completed by the Productivity and Technological Development Division of the U. S. Bureau of Labor Statistics.

It is of particular interest at this time because of rising labor and material costs. These focus management attention on efficiency—how to improve it so as to reduce unit costs. This would help lower prices or, at least, keep them from rising too sharply.

Right now price reduction efforts are designed chiefly to stall the inflationary trend, to avert boom-bust if possible. When a buyers' market —and competition—returns, better efficiency—fewer man-hours per unit—may be necessary to the very existence of a business.

The BLS study—"Trends in Man-Hours Expended per Unit for the Manufacture of Selected Machine Tools, 1939-1945"—is the first in a new program of direct reporting of productivity data.

BLS has, since 1895, prepared non-recurrent reports detailing information on unit man-hour requirements for many industries, ranging from blast-furnace production of pig iron to the making of shoes, cotton garments and electric lamps. Technological changes were analyzed.

BLS also has maintained an annual series of industry-wide indexes of productivity and unit labor cost from 1919 to the present. These indexes cover 59 manufacturing industries for the period up to 1940 but, because some industries which converted to war goods were temporarily dropped, only 32 industries since 1941.

These indexes, however, are not based on direct reports from the plants, as are those in the new program. Instead, they are derived from a combination of (1) production data compiled by other government agencies and by trade associations and (2) man-hour and wage data prepared within BLS.

Data Obtained from Plants

This type of production and labor data is not available for many important areas of manufacturing, according to BLS, notably in the industrial goods and durable consumer goods. Hence, to provide information for industries in these fields, it was necessary to obtain reports on productivity directly from the plants.

This report on trend of man-hour requirements for the production of 14 general-purpose machine tools is the first of a series. Others are in preparation, including reports on construction machinery, industrial equipment, electrical appliances and radios.

The general procedure in each industry tackled, BLS explains, "has been to obtain, directly from the individual plants, reports of the number of man-hours, direct and indirect, required to manufacture representative products or carry on typical processes."

Personal Visits Made

These statistics, then, "are supplemented by other information, reported both by the plant and by the Bureau's agents on the basis of personal visits, dealing with changes in equipment, plant layout and methods, integration of production facilities, degree of capacity utilization and relevant factors having to do with the labor force."

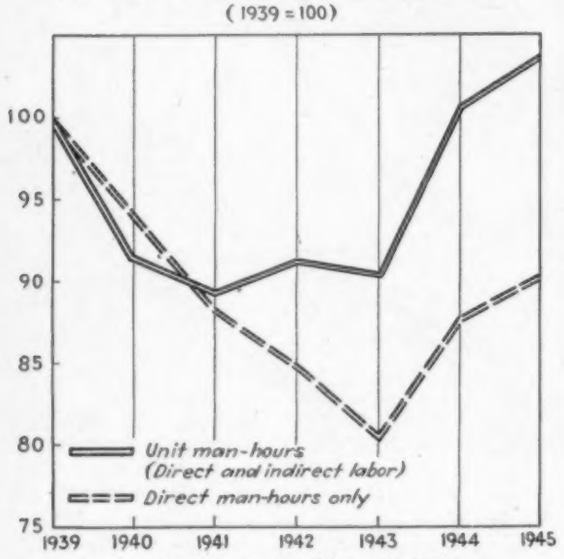
Finally, "the labor requirement statistics are reduced, either by the plant or by the Bureau, to terms of man-hours per unit of output."

Considerable preparation precedes actual collection of data, BLS points out. Industry associations, plant accountants, production men and union officials are consulted. Even before that, published and unpublished background material on the industry —its composition, structure and technology—is studied.

"Unit man-hour requirements" reported in this series measures the

UNIT AND DIRECT LABOR MAN-HOUR REQUIREMENTS FOR THE MANUFACTURE OF SELECTED MACHINE TOOLS

(1939 = 100)



Source: Bureau of Labor Statistics

Rise and Fall of Machine Tool Productivity — Unit man-hours in the manufacture of machine tools have been almost consistently higher than direct man-hours during the seven years covered by this report. In both 1944 and 1945 unit man-hours exceeded the 1939 level. The index figures used in the attached chart cover unit man-hours, including total factory man-hours as generally classified by factory accountants, which are charged to specific products. Direct and indirect labor man-hours equal unit man-hours

total hours of work required to make, in this case a single machine tool. The indexes reflect the changes in unit man-hour requirements. They rise when more man-hours are needed and decline when fewer man-hours are necessary.

This is comparable to "productivity," except that it is in reverse. "Productivity" usually means output obtained for a given unit of labor input. Thus, when productivity improves, its index would rise. Under the same conditions, the unit man-hour requirement index would decline.

Explanation of Indexes

Unit man-hour requirements indexes refer to the sum of both direct and indirect labor man-hours per machine produced. Some indexes in the machine tool study separate the direct labor man-hours. This makes it possible to compare direct and indirect man-hour requirements.

Direct hours include the work of those engaged directly on production operations, primarily machine operators and assembly workers. Indirect hours refer to functions of timekeeping, shipping and receiving, materials-handling, production scheduling, machine setup, inspection, maintenance, engineering of tools, dies and gages, and plant supervision.

Five Major Classifications

The machine tool study is divided into five major sections:

1. INTRODUCTION. Here are set forth the objectives and procedures. The indexes are described, the industry defined and the selection of products discussed.

2. UNIT MAN-HOUR REQUIREMENT INDEXES. Here the indexes are reported and interpreted, including the trend by size of company and by region.

3. INFLUENCES RESPONSIBLE FOR THE TRENDS. Here are discussed the factors tending to improve production efficiency and those tending to lower it; capacity utilization and variation in trend among products and plants.

4. RECENT TRENDS IN MACHINE TOOL DESIGN. This section considers the effects of design changes, use of carbide cutting tools, electric drives and electrical or electronic controls, hydraulic actuation, "streamlining" and welded steel bases.

5. GENERAL CHARACTERISTICS AND HISTORY OF THE INDUSTRY, wherein is treated (1) the importance of the industry (2) the size, number and distribution of plants, (3) manufacturing processes, (4) specialization, (5) customers, (6) fluctuation in production, and (7) a historical sketch.

UNIT MAN-HOUR REQUIREMENTS (DIRECT AND INDIRECT LABOR FOR THE MANUFACTURE OF SELECTED MACHINE TOOLS)

(1939 = 100)

	1939	1940	1941	1942	1943	1944	1945
All Reported Products	100.0	91.5	89.5	91.3	90.5	100.8	103.8
Boring Machines	100.0	94.5	99.8	97.0	93.1	93.9	99.5
Horizontal Boring Machines	100.0	84.1	87.3	80.0	80.5	96.5	94.6
Drilling Machines	100.0	84.0	78.7	75.1	72.5	80.9	87.2
Single-Spindle Upright Drills	100.0	97.1	95.0	95.1	96.0	98.2	108.7
Radial Drills	100.0	81.3	75.5	71.1	67.8	77.4	82.9
Lathes	100.0	89.4	89.4	92.6	91.6	115.5	107.2
Engine Lathes	100.0	96.2	95.3	93.4	100.0	107.2	100.8
Turret Lathes	100.0	82.2	77.7	81.6	81.3	105.5	102.4
Horizontal Shapers	100.0	91.4	90.3	92.8	97.2	93.6	99.3

SOURCE: Bureau of Labor Statistics

DIRECT LABOR MAN-HOUR REQUIREMENTS FOR THE MANUFACTURE OF SELECTED MACHINE TOOLS

(1939 = 100)

	1939	1940	1941	1942	1943	1944	1945
All Reported Products	100.0	94.1	88.5	85.0	80.6	87.8	90.4
Boring Machines	100.0	92.4	93.9	87.2	79.0	79.6	83.1
Horizontal Boring Machines	100.0	84.6	89.1	82.2	81.4	85.3	95.6
Drilling Machines	100.0	88.7	83.6	78.1	72.5	77.0	82.1
Single-spindle Upright Drills	100.0	103.3	100.3	98.8	95.7	92.5	96.8
Radial Drills	100.0	85.7	80.2	74.0	67.8	73.9	79.1
Lathes	100.0	89.1	86.3	86.7	82.7	103.6	100.0
Engine Lathes	100.0	97.7	96.5	93.4	91.7	95.1	91.5
Turret Lathes	100.0	80.3	89.8	68.3	67.9	90.1	94.9
Horizontal Shapers	100.0	95.3	86.4	86.3	93.0	89.3	93.3

SOURCE: Bureau of Labor Statistics

Definition of the industry is that used by the National Machine Tool Builders' Association, adopted in the 1939 Biennial Census of Manufacturers and later, used by the War Production Board's tool division.

Machine tools are defined as "power-driven complete metalworking machines not portable by hand, having one or more tool and work holding devices, used for progressively removing the metal in the form of chips"

This includes lathes, boring machines, drilling machines, milling machines, grinding, honing and lapping machines, planers, shapers, broaching machines, gear-cutting and finishing machines, threading and tapping machines, filing machines and cut-off machines such as power hacksaws and bandsaws for use on metal.

Excluded are many major types of metalworking equipment, notably forging, die-casting and shearing machines; bending machinery, punches, presses and rolling mills.

The 14 general-purpose machine tools studied were selected "to represent the broad categories of machine tools which are important in terms of value of production," BLS explains. "Special-purpose machines were excluded. With major categories, a limited number of specific tools, usually those in largest production or the most common sizes, were selected for reporting purposes."

Detailed specifications, providing for narrow ranges of sizes and other characteristics, were drawn up for the 14 selected machine tools and are attached to the BLS report as an appendix.

Of some companies in the industry, 100 were contacted. Thirty-three of them, including the great majority of the largest manufacturers, sent in satisfactory reports for at least a portion of the period covered. Three-fourths of the industry's 1939 production by value, and a substantially larger percentage of the wartime output, is represented in the major types of machine tools included in the combined index (shown in the chart on p. 166).

Extent of the coverage varied by products, but was relatively high in the indexes for the industry's

MACHINE TOOLS COVERED BY THE SURVEY

Boring Machines
1. Horizontal boring machine, standard table type.
2. Vertical boring mill.

Broaching Machines
3. Horizontal internal or internal-and-surface broaching machines.

Drilling Machines
4. Single-spindle upright drill.
5. Automatic multiple-spindle vertical drill.
6. Radial drill.

Grinding Machines
7. Reciprocating horizontal surface grinder.
8. Universal tool and cutter grinder.

Lathes
9. Engine lathe.
10. Turret lathe.
11. Automatic screw machine.

Milling Machines
12. Horizontal-type plain milling machine.

Planers
13. Double-housing planer.

Shapers
14. Horizontal-type shaper.

major products, such as horizontal boring machines, radial drills and turret lathes.

The combined index of all reported products (see chart p. 166) shows a decided difference between the trend of "unit" man-hours (direct and indirect labor) and that of direct labor alone.

Using an index of 100 for 1939, the unit man-hours needed to produce machine tools in 1940 dropped to 91.5. After hovering around 90 in 1941, 1942 and 1943, it then jumped to 100.8—slightly above 1939—in 1944. By 1945 it was up to 103.8, meaning that almost 4% more hours of work was required to build the machine tools in 1945 than six years earlier.

On the other hand, the index of only direct labor dropped further—to 80.6 in 1943—and climbed up to 90.4 in 1945, almost 10% below 1939.

This indicated a material increase in the relative importance of indidirect labor to direct labor, particularly toward the end of the war.

Factors responsible, the report holds, include additional supervision and inspection "necessitated by the lower level of skill and experience among the new recruits to the machine tool labor force."

Also: After production began to decline, the low quality of the labor force made it necessary to continue the expanded production planning and scheduling personnel.

Furthermore, "continuous operation in the machining departments was less feasible, and interruptions due to shortages of castings, electrical equipment, and other essentials became more significant, particularly toward the end of 1945."

Lathe Group Cited

The same general pattern—a decline in the earlier years of the period and a rise in the later years—is found in the indexes for individual products and product groups (Tables p. 167), although the extent of change varied between products.

The lathe group, for instance, deviated from the general pattern of the others. In unit man-hour requirements, the combined index in 1945 was 107.2, far above 1939. For turret lathes it was 102.4 and for engine lathes 100.8. The single-spindle upright drill was the only other machine, among those whose indexes was published, where the index also was above 100 in 1945. It was 108.7.

In direct labor man-hour requirements, however, none of the indexes published of selected machine tools exceeded the 1939 standard of 100. Here, again, the lathe group came off worse than the others. Its 1945 index was an even 100. Considered separately, engines and turret lathes did better, their 1945 indexes being 91.5 and 94.9, respectively.

Separate indexes are shown for only six types of machine tools. Indexes for six other machines are included in the industry-wide indexes, but are not shown separately because BLS says that publication, in these particular cases, might reveal individual company trends. Some of these products might have shown greater rises than lathes.

"For virtually all of the products and groups, the indexes of unit man-hour requirements are at higher levels in 1944 and 1945 than the indexes of direct hours only," the report states. "This means that the proportion of indirect hours to the total was generally higher than in 1930 by the end of the period covered, if not before. It is also worth noting that direct hours required per machine, although rising during the latter years of the period, had not regained the 1939 level for the published products and groups. Some of the individual reporting companies did record higher direct labor requirements per unit of products in 1945 and 1939, however."

This will point up to many companies the extent to which current high costs may be attributed to continuing inflated overhead and indirect costs.

War's Effect on Production

Larger companies, which were able to take advantage of large-scale production methods even before the war, benefited less from the rise in production levels during the war, BLS found (Table below). During the early war years, unit man-hour requirements declined in the larger plants, but not as sharply as in the medium-sized and smaller plants.

Beginning in 1943, the index rose in all size groups, reaching 110.4 in plants of more than 1,000 wage earners; 89.2 in the 251-1,000 group; 101.2 in the 101-250 group, and 86.6 in the 100 or less group.

These statistics do not imply, BLS warns, that in 1945 the larger companies were less efficient than the smaller, "since there is no basis for

UNIT AND DIRECT LABOR MAN-HOUR REQUIREMENTS FOR THE MACHINE TOOL INDUSTRY, BY SIZE OF PLANT

(1939 = 100)

Size of Group[1]	1939	1940	1941	1942	1943	1944	1945
Unit Man-Hours (Direct and Indirect Labor)							
Companies Employing:							
More than 1,000 wage earners	100.0	97.8	96.2	101.6	101.2	111.5	110.4
251-1,000	100.0	88.2	90.8	84.8	85.4	90.3	89.2
101-250	100.0	82.2	82.2	83.1	84.0	99.5	101.2
100 or less	100.0	92.1	71.3	76.7	81.9	83.8	86.6
Direct Labor Man-Hours							
Companies Employing:							
More than 1,000 wage earners	100.0	100.9	92.2	88.9	86.1	86.2	94.5
251-1,000	100.0	91.9	91.4	82.0	80.4	81.6	80.1
101-250	100.0	85.9	79.9	78.9	73.2	88.7	89.2
100 or less	100.0	94.1	84.0	81.6	85.7	85.7	90.1

[1]Reporting establishments are here classified according to monthly average of wage earners employed, *on machine tool production only*, during 1944.

SOURCE: Bureau of Labor Statistics

comparing efficiency (by size) in the year 1939, the starting point of the indexes."

Looking at unit man-hour requirements on a regional basis, BLS reported indexes for three regions—(1) East (New England and Middle Atlantic states), (2) Ohio and (3) the Middle West (excluding Ohio, but including Indiana, Michigan, Illinois, Wisconsin and Missouri). Behavior of these indexes, BLS explains, is largely determined by the plant size or other special characteristics and should not be assumed to represent solely climatic factors or inherent regional differences in efficiency of management and labor or quality of equipment.

Trends By Areas

In the East, for example, there was none of the decline in man-hours which occurred in so many other plants from 1939 to 1942. In the six years 1940-1945, the man-hour index for the East showed these changes: 100.7, 108.0, 111.8, 103.5, 114.9 and 111.5.

In Ohio it went: 96.2, 86.6, 89.5 94.8, 101.2 and 114.4.

In the Middle West (except Ohio) it went: 86.6, 90.9, 89.0, 85.3, 89.8 and 84.4.

The upward trend in the East, according to BLS, reflects the experience of the reporting large plants located in the East. These plants exercise a greater influence on the index for that region than the large plants in the other regions bear on their respective indexes.

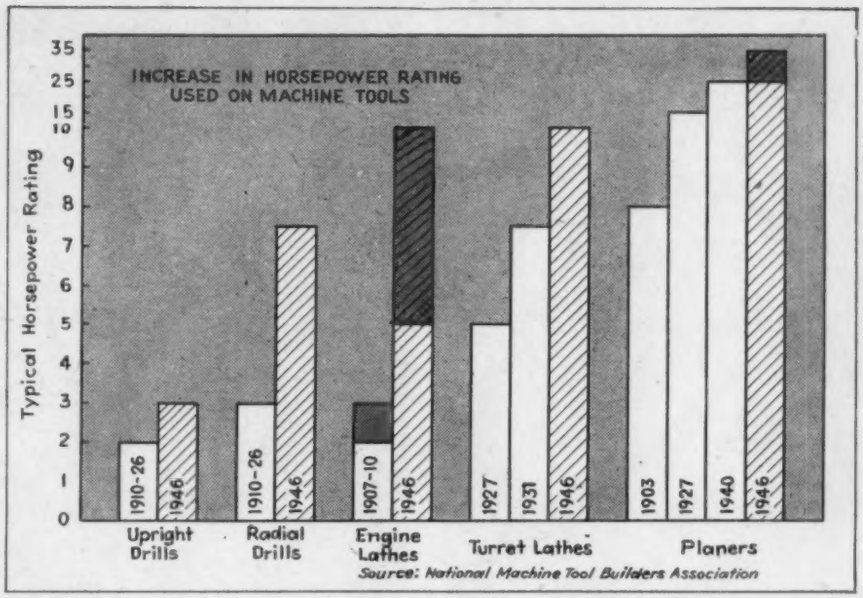
On the whole, labor requirements dropped as war production mounted and, later, rose as production of machine tools fell off. The BLS cites the following annual dollar volume of machine tool shipments, 1939-45, based on estimates of the National Machine Tool Builders Association for 1939-41 and the last five months of 1945 and on WPB reports for 1942 through July, 1945:

1939—	$ 199,949,000
1940—	442,663,000
1941—	771,465,000
1942—	1,321,748,000
1943—	1,180,216,000
1944—	497,465,000
1945—	407,315,000

Job-lot Sizes a Factor

Factors which contributed to the drop in man-hour requirements while production soared included larger job-lot sizes, increased use of jigs and fixtures, more continuous use of machines on identical or similar operations, and a narrowing and specialization of job duties in assembly machine set-up, tool grinding and other operations.

Other reasons; (1) Widespread installation of new machinery and expansion of capacity; (2) accelerated adoption of cemented carbide cutting tools; (3) use of new materials-handling equipment, and (4) relocation of equipment.



Increased Power Requirements—The introduction of new and faster metal-cutting materials, making it necessary for machine tools to run at higher speeds, has resulted in the increase in standard horsepower ratings, as shown

Adverse factors began to be felt as the production peak was reached and passed. The BLS report mentions a rise in the rate of labor turnover as skilled and more experienced employees went to war and into munitions plants. Influx of less experienced workers required more supervision and inspection. Increased production planning and scheduling personnel could not be arbitrarily cut when production fell off. Because of the lower standard labor force, high-volume practices, no longer justified, had to be continued. These included narrow subdivision of job duties, the larger inspection and supervisory force, and specialized machine set-up.

A M Inventory Used

Factors which tended to improve or lower production efficiency are discussed in considerable detail by the report. AMERICAN MACHINIST surveys of 1940 and 1945 are cited as evidence that the machine tool industry as a whole installed "an unusual amount" of new machine tools and other equipment for its own use in order to meet the unprecedented demands. AMERICAN MACHINIST's 1940 survey revealed that 73% of all machine tools in the metalworking machinery and equipment industry were more than 10 years old. In the 1945 survey it had declined to 45%.

The general trend indicated by the report, BLS explains, is representative of the great majority of plants which participated in the study, but there are some exceptions.

There were few changes in design of the machine tools produced during the period covered by the BLS report. Hence, they had little effect on the indexes of unit man-hour requirements.

Demands on Machine Tools

Over the years, machine tools have had to be adapted to meet the strain of much faster operation and a continuous increase in precision requirements. Much of it occurred before 1939, such as when high speed steel was developed, only to be surpassed later by the advent of cemented carbides.

Some general characteristics of the industry mentioned in the report:

It does not rank high in size, but "product quality and productive efficiency in a large part of our manufacturing economy is bound up to some degree with what happens in the machine tool industry."

The Middle West and New England are the important machine tool producing areas, with Ohio the leading state and Cincinnati, with 18% of the national productive capacity, the largest local area. Rockford, Ill., ranks second with Cleveland O., and Worcester Mass., also high.

Most machine tool builders make only one or two major types.

A spectacular change in the machine tool market during the war was caused by the aircraft industry. By 1940, the manufacture of aircraft and aircraft engines and parts accounted for almost 30% of domestic machine tool orders and had displaced the automobile industry as the principal domestic customer. In 1937 it bought only 2%.

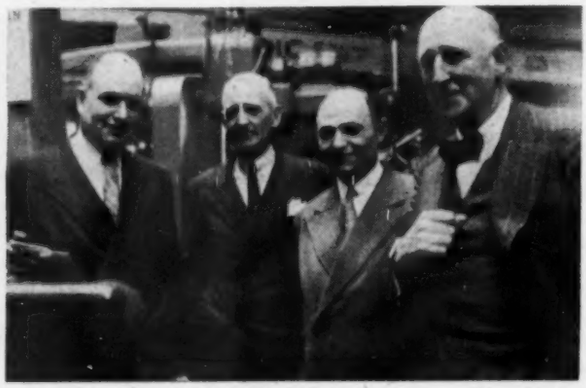
U.S. Machine Tools ATTRACT INTEREST AT PARIS FAIR

On hand at the Stokvis stand were (l. to r.) W. W. Reynolds, James A. Urban, and Noble B. Clark, export manager, all of Warner & Swasey Co.

French Lathe Development—A turret lathe, developed by Henri Bruet jr., is demonstrated by F. Eilert Fernier, director of Fenter Ltd., who bought license to build machine in Britain. Peter Trippe of the McGraw-Hill magazine "The Machinist," London, watches the demonstration at the Paris Fair

Americans at the Fenwick stand (l. to r.) Charles Welte Fellows Gear Shaper Co.; George Gray and Harold Ashton, National Broach; Edward Tremblay, Bullard; W. N. Woodruff, Gleason Works; and Russ Knights of Jones & Lamson

(McGraw-Hill World News Photos)



Shown at the Horstmann stand (l. to r.) are R. B. Holding, Bryant Machinery & Engineering Co.; T. A. Stoddart, Barber-Colman Ltd.; A. M. Gruner, Michigan Tool Co., Colonial Broach Co., and Detroit Tap & Tool Co.; and Henri Nourry, Horstmann

PARIS—(McGraw-Hill World News)—Prospective European buyers received their first view of many new U. S. machine tools—about 50 types were on display—in Machinery Hall at the Paris Fair last month. French and American displays were the largest in the machinery group.

French, British, Swiss, Belgian, Italian, Swedish and Czech manufacturers exhibited much equipment seen at the Fair last year. There were 8,600 exhibitors, an increase of more than 1,000 over last year. Daily attendance averaged 150,000.

Exhibitors reported taking many orders and were impressed by the volume of inquiries. All orders are subject to import licenses.

One show feature was a new French turret lathe developed by Henri Bruet jr., for Etablissements A. Cazeneuve. Volume production will not be reached for a year.

Among exhibitors at the Alfred Herbert stand at the Fair were (l. to r.) N. B. Peck, European mgr. of Heald Machine Co.; Milton H. Nichols and Ralph J. Kraut, the latter president of Giddings & Lewis Machine Tool Co.

The lathe has a normal maximum of 3,200 rpm, though it can be geared up to 5,000 rpm, and has 18 speeds. Normally there is 1 meter between centers, but this can be altered to 1½ or 2 meters. Swing is 500 mm. over the bed; 450 mm. over the saddle, and 220 mm. over the slide. Sixty-two feeds are available. Micrometer adjustment is down to 0.005 mm. The motor can be reversed up to 10 times a minute.

Most U. S. exhibitors were on the stands of a few big French machinery agencies: Alfred Herbert, Stokvis et Fils, Etablissements Horstmann, Etablissements Fenwick, D.A.V.U.M., Forges de Vulcain. In all, 214 American firms, chiefly machinery makers, were represented.

Lower Output, Prices, Profits Seen in Economic Report Data

WASHINGTON—During the rest of this year, production, prices, profits and hours worked per week will all be lower than in the same period of last year. Labor productivity, labor costs, wage rates, inventories and plant capacity will all be higher.

That's the view of some 600 men who—in the eyes of Dunn & Bradstreet—are outstanding leaders in business, labor, agriculture and economics. It's the consensus indicated by returns from a questionnaire circulated by D & B for the Congressional Joint Committee on the Economic Report.

To the businessmen, the recession looked for will be in other lines. Most of them expect their own industry to be less affected than others, their own firm to feel no pain at all.

In contrast, labor leaders polled expect their particular industries to suffer more than most.

Perhaps at heart the respondents expect a recession in which wages and employment will be harder hit than prices and profits.

The survey doesn't pretend to be a properly weighted opinion poll. No effort was made to obtain a scientific sample. Questionnaires were returned by about 400 businessmen, about 100 dirt farmers, 14 labor leaders, 35 economists and 19 journalists.

Industry to Play Greater Role In Atomic Military Projects

WASHINGTON — The Atomic Energy Commission is gearing itself for an atomic armament race. This is borne out by the Administration policy that negotiations on international control of atomic energy are getting nowhere.

The atomic program will place increased emphasis on research and engineering that can show results—in the next two, three or four years—in increased and improved production of fissionable material.

It means that last fall's preoccupation with industrial and beneficial applications of nuclear energy are moving into the background; it means secrecy on atomic matters is being tightened rather than relaxed.

Power generation work has not by any means been abandoned. For one thing, at the present stage of development, there is practically no distinction between work on industrial power and work on atomic propulsion for ships or aircraft.

The current trend of AEC policy is to throw projects leading toward military objectives into the hands of industry, where early applications can be engineered on the basis of existing knowledge.

Names in the News

C. F. Kettering

C. L. McCuen

Charles F. Kettering has retired as vice president in charge of the research laboratories of General Motors Corp., Detroit, and **John T. Smith,** vice president and general counsel, has also retired. **Charles L. McCuen,** vice president in charge of the engineering staff, succeeds Mr. Kettering as general manager of the research laboratories division, while **James M. Crawford,** general assistant to Mr. McCuen, has been elected vice president in charge of the engineering staff. **Henry M. Hogan,** vice president and assistant general counsel, has been named to succeed Mr. Smith. Mr. Kettering, who joined General Motors in 1920, will remain as a director and consultant for the company.

Charles J. Hardy, Jr., formerly executive vice president of American Car & Foundry Co., New York, has been elected president to succeed **F. A. Stevenson,** who has resigned.

E. A. Irwin

Ray H. Sullivan

E. A. Irwin, general sales manager of E. W. Bliss Co., was elected vice president in charge of sales at a recent board meeting, and **Ray H. Sullivan,** Brooklyn division manager, was named vice president in charge of manufacturing.

Frederick B. Collins, sales manager since 1938, and **Edward C. Wells,** chief engineer since 1943, have been elected vice presidents of Boeing Airplane Co. and Boeing Aircraft Co.

George H. Pratt, general sales manager and member of the board for two years, has been elected vice president in charge of sales of the Hudson Motor Car Co., Detroit.

George S. Starke, general sales manager of Sperry Gyroscope Co., Inc., New York, has been named vice president of the firm.

Val Lee, treasurer of The Sidney Machine Tool Co., Sidney, Ohio, for the past 18 years, has been appointed president to fill the vacancy created by the death of **F. P. Thedieck.**

Val Lee

George E. Winters

George E. Winters, recently vice president and assistant to the president, has been elected executive vice president of Continental Motors Corp., Muskegon, Mich. **Lloyd Morrow,** former factory manager in charge of the automotive engine division, has been elected vice president in charge of management-labor relations, while **Frank H. Hull,** comptroller since 1940, has been elected vice president in charge of the shop control divison.

Julius J. Domonkos, vice president of Bell Aircraft Corp. and manager of the Burlington, Vt., Div., has been named vice president in charge of manufacture, while **Robert M. Stanley,** chief engineer of the firm since 1944, has been named vice president of engineering. Bell announced the resignations of **Charles L. Beard,** vice president and director, and **D. Roy Shoultz,** vice president.

George A. Smith has been named general manufacturing manager of the New Departure Div., General Motors Corp., with headquarters in Bristol, Conn.

Thomas G. Hart has been appointed general sales manager of The Whiton Machine Co., New London, Conn.

E. J. Helline

A. H. Milnes

Edward J. Helline, who has been in charge of snap ring sales engineering and production for the past three years, has been appointed general sales manager of the Reliance Div., Eaton Manufacturing Co., Massillon, Ohio.

A. H. Milnes has been appointed chief engineer of The Steel Improvement & Forge Co., Cleveland. He was formerly associated with the Bristol Aeroplane Co., Ltd., Bristol, England.

Dr. Charles A. Thomas, vice president and technical director of Monsanto Chemical Co., Springfield, Mass., has been elected executive vice president. Dr. Thomas, who received the War Department Medal of Merit for his work in atomic energy, will continue as technical director and member of the executive committee.

J. G. Paule has been appointed vice president and assistant general manager of Wilson Foundry & Machine Co., Pontiac, Mich. He formerly served as secretary and treasurer. **B. E. Drury,** sales manager, was named general sales manager.

H. B. Walters, formerly assistant works manager at Pittsburgh for the Allis-Chalmers Mfg. Co., Milwaukee, has been named works manager of the company's Boston works.

Earl R. Mellen, executive vice president and treasurer of The Weston Electrical Instrument Corp., Newark, N. J., since 1944, has been elected president of the firm, succeeding **Caxton Brown,** who has been appointed to the newly created position of chairman of the executive committee.

Dr. Stephen J. Zand has been appointed vice president in charge of engineering of the Lord Manufacturing Co., Erie, Pa. He served as a consultant to the firm since 1933.

Clarence W. Coe has been named manager of the new Decatur, Ill., works of the General Electric Plastics Div. He was formerly manager of the division's Ft. Wayne, Ind., operations which will be transferred to Decatur.

BUSINESS ITEMS

Link-Belt Co., Chicago, has reestablished a sales office in Washington, D. C., at 1009 Washington Gas Light Bldg., 11th and H St., N.W. **C. R. Heller,** Washington representative, will be in charge.

The Carpenter Steel Co., Reading, Pa., has opened a Los Angeles warehouse and office at 1939 E. 16 St. **D. J. O'Neil** has been appointed Pacific Coast manager in charge of the Los Angeles warehouse.

Anker-Holth Manufacturing Co., Port Huron, Mich., has appointed **Tool Service for Industry,** 140 N. Dearborn St., Chicago, as its exclusive representative for its air and hydraulic chucks and cylinders, control and regulating valves, etc. in that area.

D. J. Murray Manufacturing Co., Wausau, Wis. has moved its Chicago office to First National Bank Bldg., 38 S. Dearborn St.

The William Sellers & Co., Inc. buildings and machinery at 16th and 17th Sts., Reading, Pa., have been sold to **Harry H. Robinson.**

Industrial Instrument Service Co., 42-17 35th Ave., Long Island City, N. Y., has incorporated under the name of **Industro Corp.** The firm has expanded its facilities to include the engineering and fabrication of process control systems and the assembly of completely wired and piped instrument panels.

The MGW Co., a machine shop, has been formed in Hinsdale, N. H. with **Edward Maynard, Leo Grattan** and **Harold R. Weeks** as partners. The shop is equipped to do all kinds of general machine shop work, including tool and die work and electric and acetylene welding.

Ampco Metal Inc., Milwaukee, Wis., has appointed the **J. B. Ripley Brass Foundry** of Windsor, Vt. as its licensee in that area, with authorization to produce and sell Ampco metal castings as well as to stock and sell other copper-base alloy products in Vermont and New Hampshire.

Michigan Tool Co., Detroit, has appointed **Vittetow, Inc.,** 1439 Detroit St., Denver 6, Colo., as its exclusive representative in Colorado, Utah and Wyoming.

Belsaw Machinery Co., 315 Westport Ave., Kansas City, Mo., has been incorporated with $150,000 authorized capital stock by **E. Stanley, Mary T., E. Stanley, Jr.,** and **Kathleen B. Field** and **Roy Sawnson.**

Automatic Transportation Co., Chicago, has appointed **T. C. Coleman & Son,** Lousiville, Ky., as its sales representative in that area.

Clearing Machine Corp., Chicago, has purchased the **Jackson Machine Co., Inc.,** Rockford, Ill., which will be operated as a division of Clearing.

The Yankee Precison Products Co., Hartford, Conn., designers and builders of electronic and mechanical gages, tools and equipment, has consolidated with **Modern Tools,** Berlin, Conn. Offices and manufacturing facilities will be located in Berlin and Modern Tools will operate as a division of Yankee. **Edmond Morancey** is general manager and **W. Krause,** general sales manager.

OBITUARIES

Arthur B. Betz, who had been in the steel warehouse business for 55 years, died May 29. For the past 15 years he has been owner and director of S.A.E. Steels, Cleveland.

George L. West, retired production manager of the John Deere Plow Co., Syracuse, N. Y., died recently after a long illness.

William A. Morgan, president of the former Buffalo Copper & Brass Rolling Mill, passed away May 27.

C. Breckenridge Porter, 66, former president of the Sizer Forge Co., Buffalo, succumbed May 25. He was associated with Bell Aircraft Corp. during the recent war.

Thomas S. Hemenway, 65, president and founder of the Metal & Alloy Specialties Co., Inc., Buffalo, died suddenly May 25. He was also president of the National Non-Ferrous Foundrymen's Association.

MEETINGS

American Society for Testing Materials. Annual meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. June 16-20. R. J. Painter, 1916 Race St., Philadelphia 3.

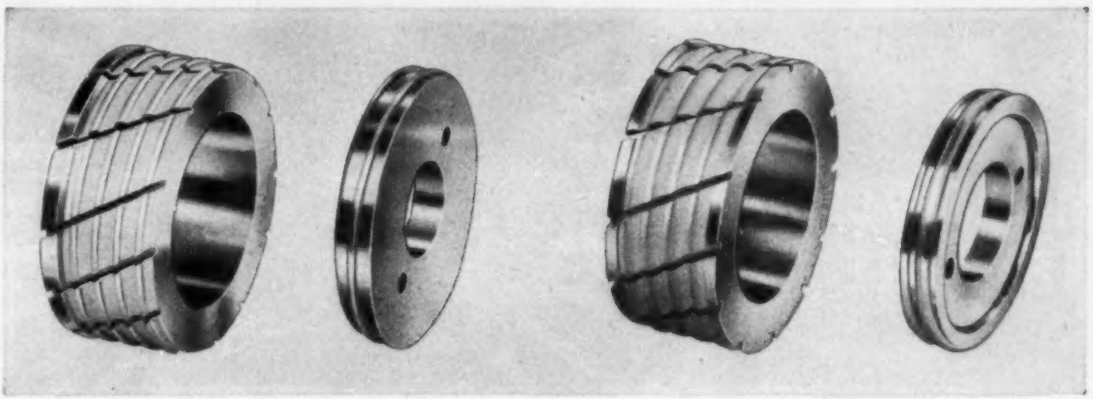
American Society of Mechanical Engineers. Semi-annual meeting. Stevens Hotel, Chicago. June 15-19. Ernest Hartford, executive assistant secretary, 29 W. 39 St., New York 18.

Machinery Dealers National Association. Convention. Netherlands Plaza Hotel, Cincinnati, Ohio. June 17-19. R. K. Vinson, executive director, 20 N. Wacker Dr., Chicago.

SHEFFIELD MACHINE TOOL DATA

MFG #111

CRUSH GRINDING CUTS MANUFACTURING COSTS OF SMALL AND LARGE SCREW CAP FORMING ROLLS



From left to right - (1) Crusher roll for truing the grinding wheel used to produce the internal die; (2) The resultant internal die; (3) Crusher roll for external die; (4) The external die.

The inner and outer rolls or dies used to roll the thread on jar lids have heretofore been made by chasing on a lathe with a tool formed to the desired thread profile. The rolls are then heat treated and polished. Distortion of form occuring in heat treating is a common cause for rejects.

This problem has been eliminated, production time greatly reduced and uniformity of quality assured by the following methods:

(1) Crusher rolls to desired thread profile are made on standard H.S.S. blanks with the Sheffield Micro-Form Grinder.

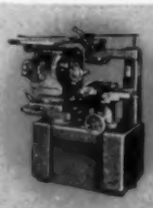
(2) The resultant crusher roll is used to dress a 120 grit wheel on the Sheffield Precision Thread and Form Grinder

(3) This Sheffield Precision Thread and Form Grinder is then set up to grind the dies in quantity with two passes of the grinding wheel over the work.

While it was possible to produce the form in a single pass at reduced work speed, the most desirable combination of production time and product finish was obtained by taking two passes, one for rough grinding and one for finish grinding.

In grinding, two parts were placed on an arbor. Total grinding time per part was slightly under 4 minutes. Approximately an hour's labor per die is saved by using crush grinding on Sheffield equipment, and the die so produced is more uniform in quality and the finish is better.

Thousands of other production cost problems can be answered satisfactorily by crush grinding with Sheffield equipment. Write for Bulletins M-100-145 and M-120-144.



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Dayton 1, Ohio, U. S. A.

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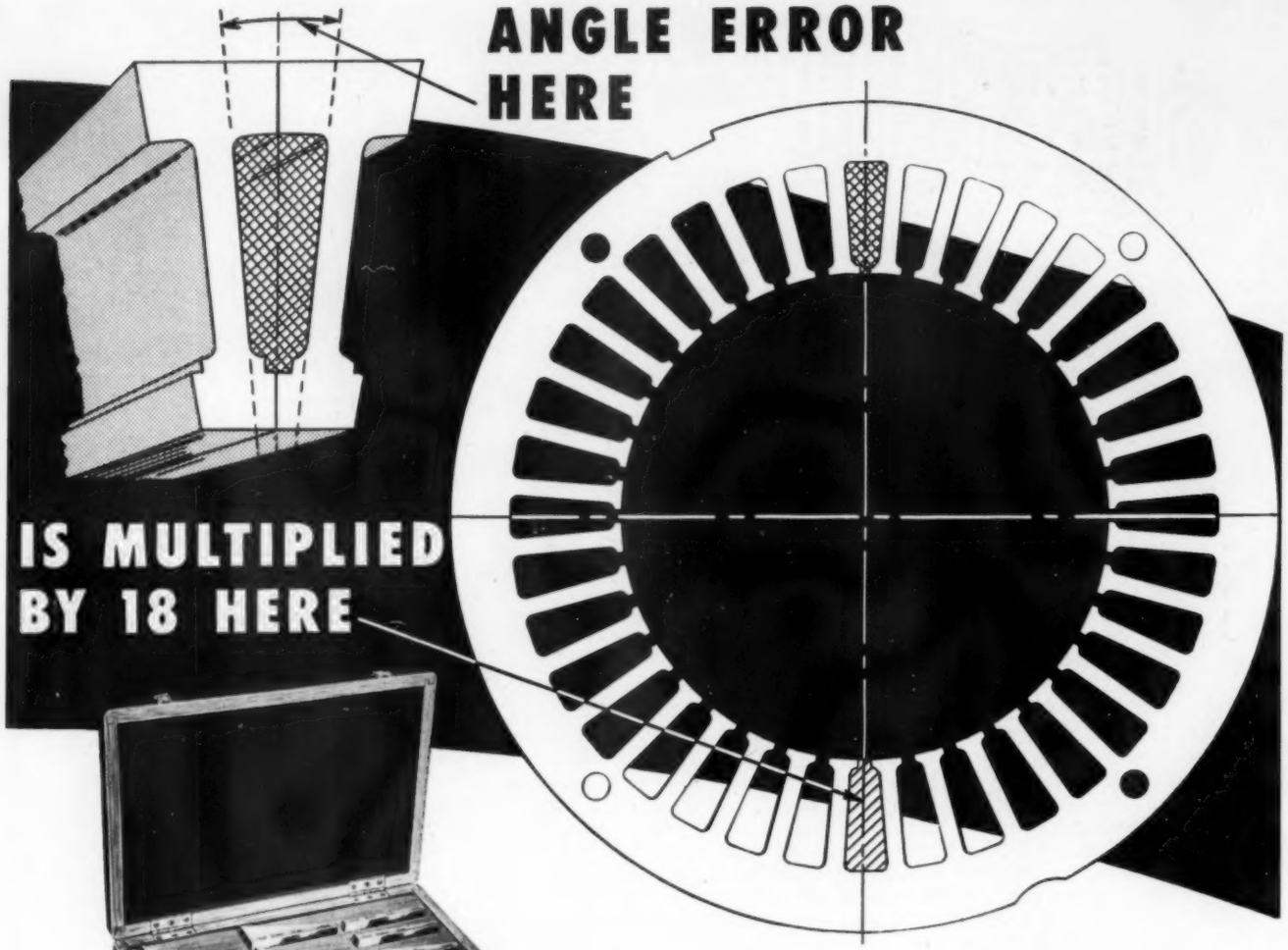

(Upper Left) Typical cross section in lamination die. Angle accuracy is important as each error in original die segment is added to identical error in adjacent segments.

Webber Angle Gage Blocks detect errors that pass unnoticed in routine sine bar practice. The blocks not only replace the sine bar but provide a check on misalignment or wear within the sine bar itself.

Furthermore, Webber Angle Blocks are simple to apply. An average inspector automatically becomes an authority on angular measurement for the proof is contained within the blocks themselves.

The blocks can be used as master gages or for routine inspection of fixtures, tools, indexing devices and dividing heads. They are accurate to $\frac{1}{5,184,000}$ part of circle. They provide the only sure fire test of angle accuracy available today. Write for bulletin.

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- ★ Gage Block Sets in Steps of .00005".
- ★ Individual Special Size Blocks.
- ★ Heavy Duty Gage Blocks.
- ★ Angle Gage Blocks in Steps of one second.
- ★ Carblox (Carbide) Wear Gages.

Webber
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"D" Flange Mounting for Electric Motors

The Motor and Generator Section, National Electrical Manufacturers Association has announced development of a "D" flange mounting, which is a universal flange mounting for both horizontal and vertical end-shield mounted electric motors.

SOON after the adoption of mounting dimensions for horizontal motors in 1930, the Section gave its attention to the problem of standardizing the mountings for vertical-shaft motors. The first standard covered a ring base having a diameter larger than the motor frame. This was the NEMA "V" mounting.

To fill the desire for end-shield mounted horizontal motors, particularly for machine-tool application, dimensions were worked out for a special flange, standardized as the NEMA "A" flange mounting. Later, modified as the NEMA "B" flange, it had considerable acceptance in the machine-tool industry because of its smaller over-all diameter.

Experience over the years with these mountings indicated the possibility of developing a single mounting, which would serve for both vertical and horizontal shaft end-shield mountings, and would be particularly acceptable to the machine-tool industry through change from the female rabbet fit characteristic of the "B" flange standard.

To this end a joint committee of representatives from NEMA and the National Machine Tool Builders Association was formed to consider the standardization of motors applied to machine tools. This committee developed a new flange known as the NEMA "D" and established flange dimensions for motors built in frames 203 to 505, which cover ratings from 1 to 125 hp., inclusive, at 1750 rpm. Five "D" flanges accommodate the spread of the sixteen different NEMA standardized motor frame sizes.

This new flange has four principal features, apparent in the illustration, which are marked improvements.

1. The NEMA "D" flange has a male rabbet.
2. The face of the NEMA "D" flange is in line with the shaft shoulder.
3. The diameter of the flange is not greater than the diameter of the motor, except on frames 203 and 204.
4. The motor mounts on the machine from the motor side. Mounting bolts go through the flange from the motor side.

With this mounting, the only machining necessary on a machine tool or other machine frame, upon which the motor fits, covers an area equal to the diameter of the rabbet. It is not necessary to finish the larger surface needed where a female rabbet fit is used. The exact location of gears, pulleys or couplings can be predetermined regardless of what make motor will eventually be installed, and no extra machining is needed to accommodate the larger shaft diameter above the shoulder.

Flanges for smaller motors have four holes for mounting bolts—those for larger motors are provided with eight holes to carry the extra weight. Motors built with NEMA "D" flanges can be had either with or without conventional motor feet.

The new standard design which can be used in place of three former

Dimension Sheets for Type D Flange Mounted Motors (with feet)

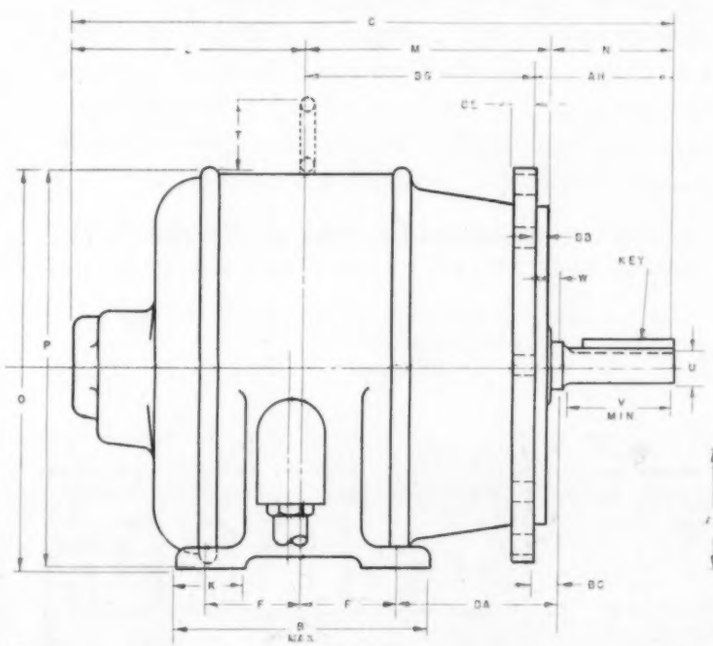


Fig. 1

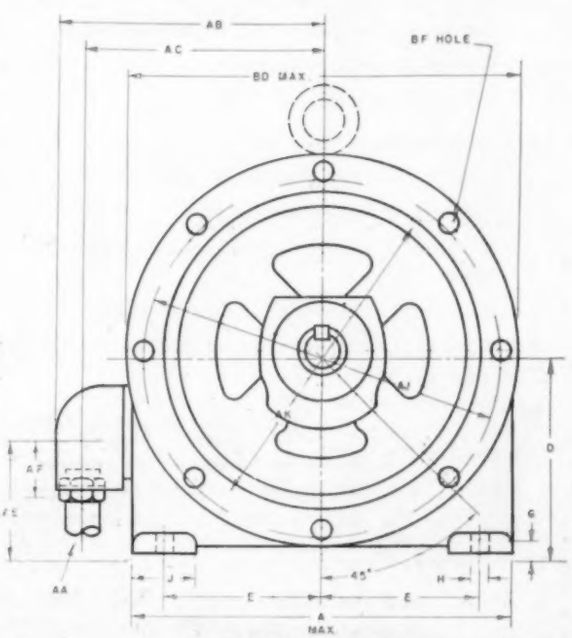
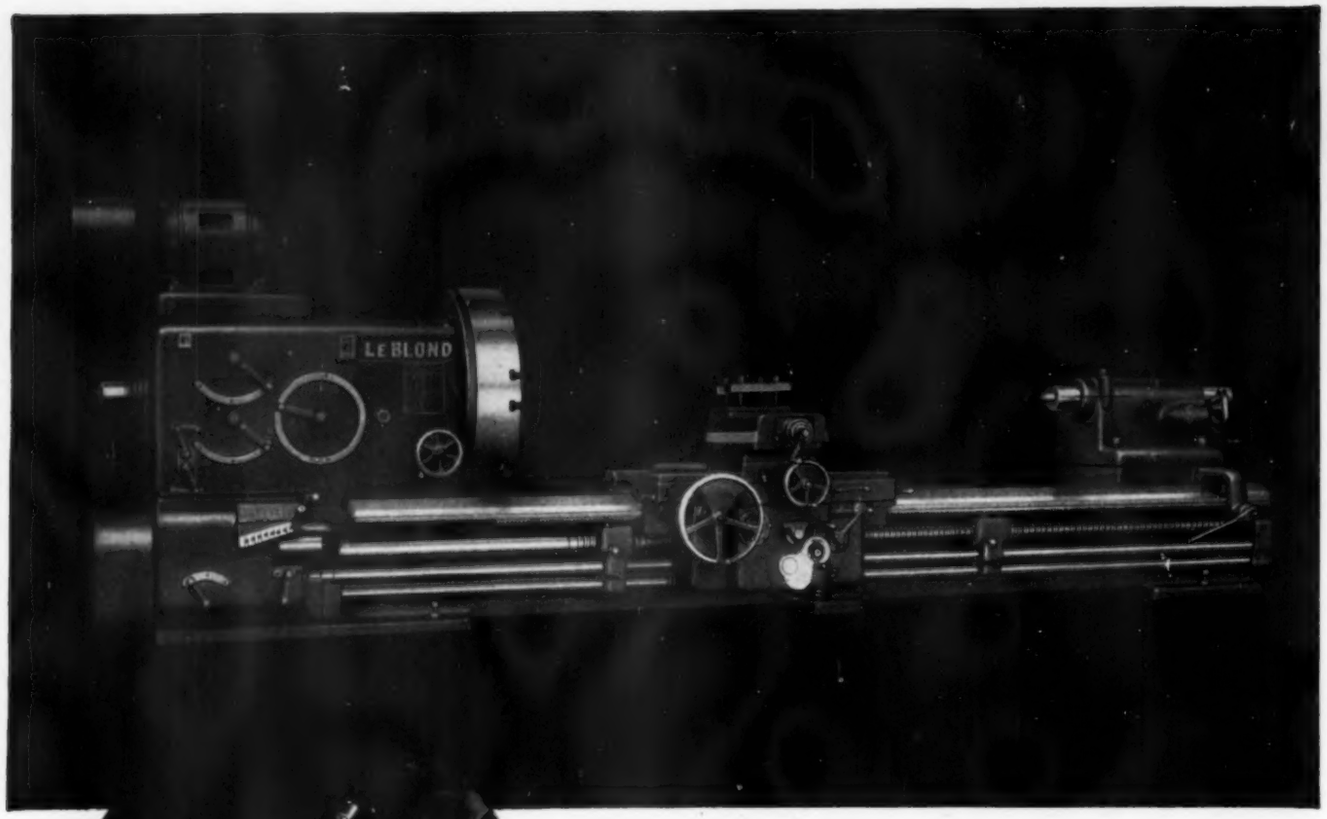


Fig. 2

NOTE: Where 4 holes (BF) are used they are on the 45 degree from the horizontal and vertical center lines.



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THE 40" AND 50" LEBLOND HEAVY DUTY ENGINE LATHES

40"-50" STANDARD FEATURES

- Feed box totally enclosed, lubricated automatically.
- 27-speed geared headstock.
- Periphery-driven face plate . . . 18 speeds.
- Flame hardened steel bed ways.
- Power rapid traverse moves carriage electrically.
- Power angular feed to compound rest.
- One-piece apron with positive jaw feed clutch, lubricated automatically.
- Apron electric control starts, stops, and reverses spindle.
- Thrust lock tailstock with worm and rack construction.

Big lathes for big jobs. Gigantic in size, yet these powerful lathes are extremely easy to operate . . . produce the accuracy associated with much smaller LeBlond lathes. They present the capacity, power, and stability necessary for turning work of huge proportions. Smartly engineered, ruggedly constructed, they will hold their dependable accuracy for years. Send for complete information today.

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LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES

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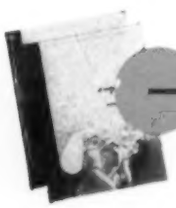

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FOR THE VERY LATEST in modern lathes, be sure to see our complete line in action at the MACHINE TOOL SHOW, DODGE CHICAGO PLANT, September 17-26. You're always welcome at the LeBlond booth—conveniently located close to the main entrance.

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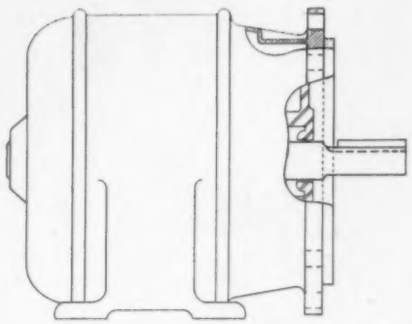
LEBLOND



Schematic diagram of motor with new NEMA "D" flange mounting

designs confers obvious benefits on the machinery and tool builder, the motor manufacturer, and the motor user.

In addition to the mechanical advantages of the new design, other benefits which can accrue to suppliers of motor-equipped machines and their customers are: uniformity of flange mounting details among those motor builders who follow the NEMA standard, wider availability and interchangeability of motors, quicker delivery, increased sources of supply, and a reduction in standby requirements for protection against emergency shutdowns.

Standard Dimensions for Flange-Mounted, D-c and A-c Motors, Type D

Frame No.	AK*	AJ	BD (Max.)	AH	BC	U	Key Width	Key Thickness	Clearance Holes B F Size	Clearance Holes B F Number
203D	9	10	11	2 1/4	0	3/4	3/16	3/16	17/32	4
204D	9	10	11	2 1/4	0	3/4	3/16	3/16	17/32	4
224D	9	10	11	3	0	1	1/4	1/4	17/32	4
225D	9	10	11	3	0	1	1/4	1/4	17/32	4
254D	9	10	11	3 3/8	0	1 1/8	1/4	1/4	17/32	4
284D	11	12 1/2	14	3 3/4	0	1 1/4	1/4	1/4	13/16	4
324D	11	12 1/2	14	4 7/8	0	1 5/8	3/8	3/8	13/16	4
326D	11	12 1/2	14	4 7/8	0	1 5/8	3/8	3/8	13/16	4
364D	14	16	18	5 5/8	0	1 7/8	1/2	1/2	13/16	4
365D	14	16	18	5 5/8	0	1 7/8	1/2	1/2	13/16	4
404D	14	16	18	6 3/8	0	2 1/8	1/2	1/2	13/16	4
405D	14	16	18	6 3/8	0	2 1/8	1/2	1/2	13/16	4
444D	18	20	22	7 1/8	0	2 3/8	5/8	5/8	13/16	8
445D	18	20	22	7 1/8	0	2 3/8	5/8	5/8	13/16	8
504D	18	22	25	8 5/8	0	2 7/8	3/4	3/4	13/16	8
505D	18	22	25	8 5/8	0	2 7/8	3/4	3/4	13/16	8
364SD	14	16	18	3 1/4	0	1 5/8	3/8	3/8	13/16	4
365SD	14	16	18	3 1/4	0	1 5/8	3/8	3/8	13/16	4
404SD	14	16	18	3 3/4	0	1 7/8	1/2	1/2	13/16	4
405SD	14	16	18	3 3/4	0	1 7/8	1/2	1/2	13/16	4
444SD	18	20	22	4 1/4	0	2 1/8	1/2	1/2	13/16	8
445SD	18	20	22	4 1/4	0	2 1/8	1/2	1/2	13/16	8
504SD	18	22	25	4 1/4	0	2 1/8	1/2	1/2	13/16	8
505SD	18	22	25	4 1/4	0	2 1/8	1/2	1/2	13/16	8

All dimensions in inches.
*The tolerance for the AK dimension shall be +0.000, —0.005 in.
Note I—See Fig. 1, 2, 3 and 4 for the meaning of the letter dimensions.
NoteII—These dimensions may also be applied to vertical motors, in which case the frame designation may have the suffix letters DV or SDV.

Dimension Sheets for Type D Flange Mounted Motors (without feet)

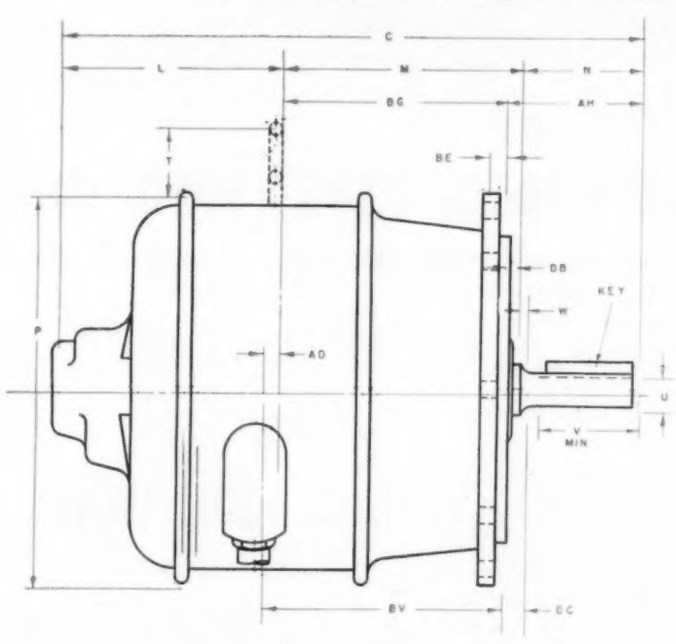


Fig. 3

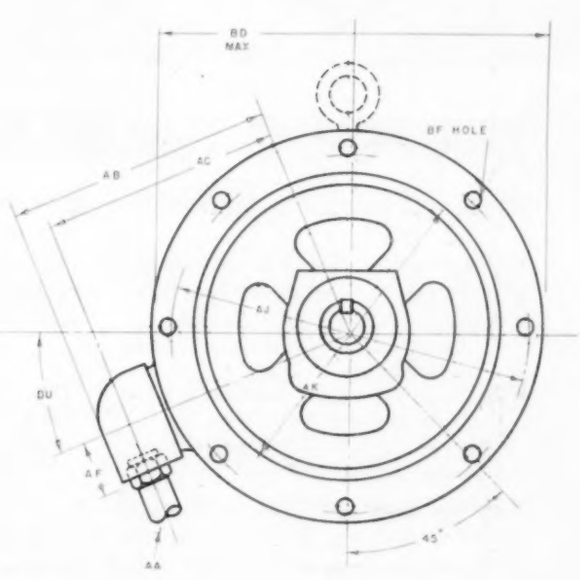
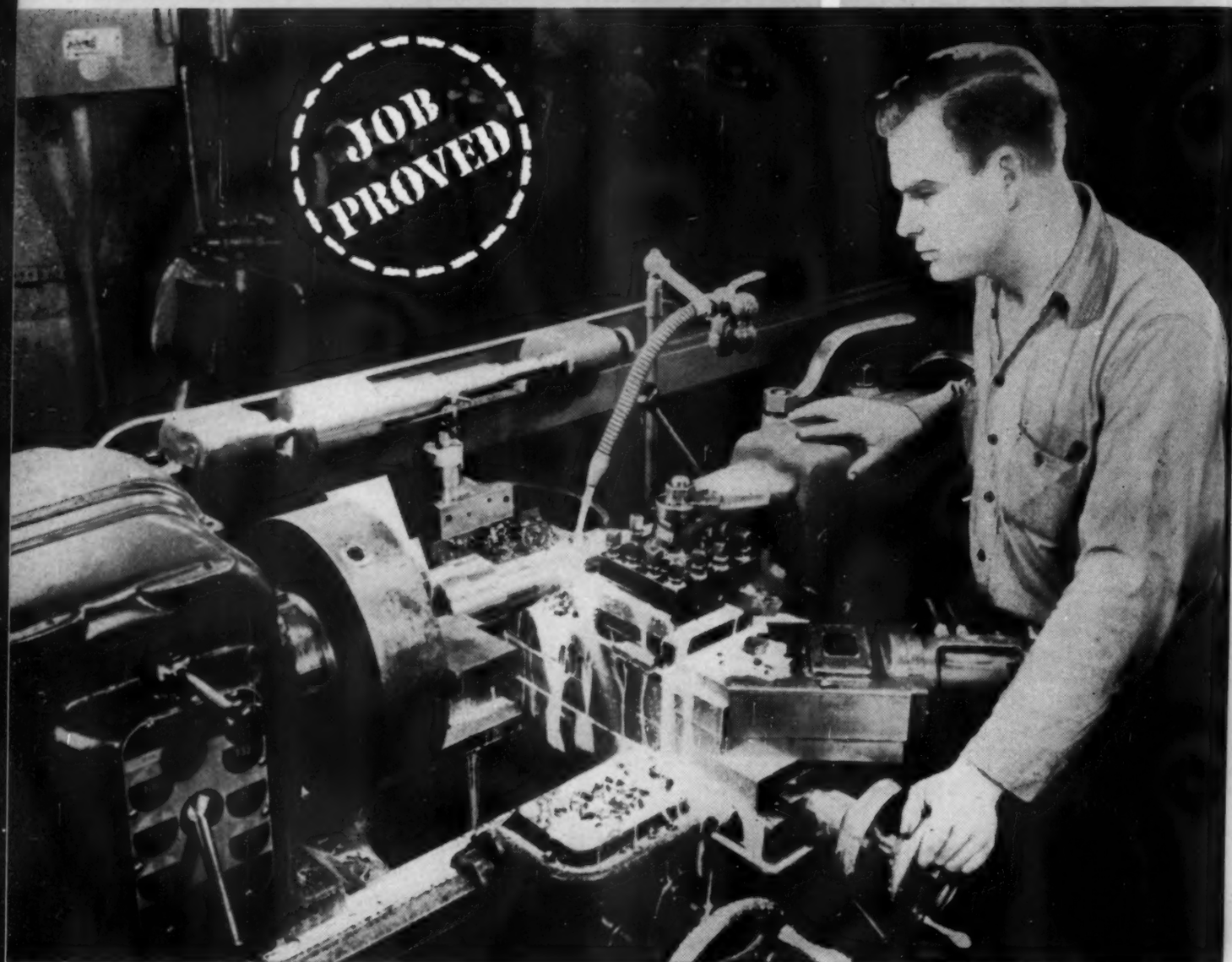


Fig. 4

NOTE: Where 4 holes (BF) are used they are on the 45 degree from the horizontal and vertical center lines.

Turning S.A.E. 4145 Annealed . . . 315 S.F.P.M.



SUNOCO EMULSIFYING CUTTING OIL

Cools and Lubricates Carbide Tool Removing approximately 23 Cubic Inches of Metal per Minute

Here are the facts on a typical job where Sunoco Emulsifying Cutting Oil makes possible heavy cuts on annealed 4145 steel.

- **Operation:** Turning 4½" shaft and removing approximately 23 cu. in. of metal per minute
- **Machine:** 16" x 54" "AMERICAN" Pacemaker multi-production lathe
- **Material:** S.A.E. 4145 annealed steel
- **Spindle Speed:** 280 R.P.M.
- **Depth of Cut:** ⅜"
- **Cutting Speed:** 315 S.F.P.M.
- **Feed:** .017"
- **Type of Tool:** Cemented carbide
- **Cutting Lubricant:** 1 part Sunoco to 20 parts water

Sunoco Emulsifying Cutting Oil forms a stable emulsion when mixed with water. Its lubricating and cooling qualities make it particularly efficient for precision work at high speeds.

For more production . . . better finish . . . longer tool life . . . call your Sun Cutting Oil Engineer or write Department AM-6.

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INDUSTRIAL PRODUCTS

Piping for Fluid-power Systems

COURTESY THE OILGEAR COMPANY

TUBING AND FITTINGS. For durable, leak-proof and trouble-free fluid power lines, seamless-steel tubing with forged-steel flareless, locking-shoulder fittings are satisfactory in pipe sizes up to ¾ in. For larger pipe sizes, use seamless-steel tubing with forged-steel screwed or socket-weld hydraulic fittings. Steel tubing used with forged-steel hydraulic fittings should be specified as "low-carbon, low-sulphur, cold-drawn, seamless steel tubing with 1200 F. anneal" and free of internal scale, draw marks or scratches. The anneal is specified to facilitate bending. If tubing is not to be bent, warehouse stock free of internal scale, draw marks or scratches will be satisfactory.

When pressure does not exceed 1000 psi., lines are short and little vibration is present, copper tubing with extruded brass flare fittings or flareless, locking-shoulder fittings can be used. The copper tubing must be dead soft and free of drawing marks.

CLEANLINESS. Be sure all tubing is thoroughly cleaned of saw and file chips, dirt, abrasives, scale, slag, burrs, solvents and other foreign matter which might restrict the oil flow, cause damage to the equipment or interfere with the welding or brazing of joint. Use only clean, lint-free rags.

INSTALLATION. Select the path of shortest feasible length but avoid straight-line connections, especially when distance between connection is short. Include at least one simple bend for expansion and contraction due to temperature changes. Keep the radius of bend above 3 pipe diameters. Do not use tubing with kinks, flattened bends or wrinkles. Use as few fittings as possible, especially 90° fittings. Include tees or provide small auxiliary pipe taps for installing test gages. All tubing should be made up so that it will fit without straining into position. Tubing may be heated to a low temperature over a large area, if necesssary, to remove strains. Install suitable supports and braces wherever tubing might vibrate. Protect tubing against mechanical loads and abuses. When fittings packed with copper gaskets are removed from units, these gaskets should be annealed before reassembly.

FLARELESS, LOCKING-SHOULDER JOINT. Cut tubing square. Carefully burr inside and outside. Assemble nut and ring to tube. Insert tube into fitting. Bring nut down on sleeve and make finger tight. Tighten nut about 1½ turns with wrench; never more than 2 turns. In reassembly, pull nut up finger tight and then give ⅛ turn only with wrench.

SCREWED TUBE CONNECTIONS. Use sharp, standard pipe taps and pipe dies and a good cutting oil for cutting general-purpose pipe threads. Better pipe threads for tighter joints can be cut with sharp, special pipe taps and pipe dies having only a ½° rake angle. For self-sealing tight joints without the use of compound, use dryseal form pipe taps and pipe dies. Permatex, tinning, lacquer, litharge or similar materials should be used sparingly and kept out of the hydraulic systems. Never use shellac.

Copper Tubing

For Flared and Flareless, Locking-Shoulder Fittings*

Pipe Size	O.D., in.	Wall for 500 psi.	Wall for 1000 psi.
⅛	¼	0.035	0.035
¼	⅜	0.050	0.050
⅜	½	0.065	0.065
½	⅝	0.065	0.065
¾	⅞	0.065	0.090
1	1⅛	0.065	0.110
1¼	1¼	0.065	0.120

**FERULOK STEEL FITTINGS—The Parker Appliance Company, Cleveland, Ohio.*

WELDED TUBE CONNECTIONS. If socket-welded fittings are used, tack-weld fitted tubing to fittings before removing line from units to complete welding operation. If screwed fittings are used, also remove fitted tubing and fitttings from unit for welding operation. Support tubing and fittings with clamps or fixture. Preheat tubing and fitting joint to approximately 300 F. Avoid concentrating heat. Use any AWS 6010 or 6011 electrode. Be sure weld fills socket, covers all exposed tube threads and forms a smooth fillet to eliminate stress concentration. Allow welded joint to cool naturally. Remove all scale or slag on joint and in tubing before assembling line to the fluid power units.

BRAZED TUBE CONNECTIONS. Remove fitted tubing and fittings from unit for brazing. Support with clamp or fixture. Heat fitting and tubing slowly and evenly to a point at which rod will flow and alloy properly. Direct flame against fitting rather than against tubing. Use Oxweld Rod No. 25M, or equivalent. Be sure brazing material covers all exposed pipe threads with a smooth fillet.

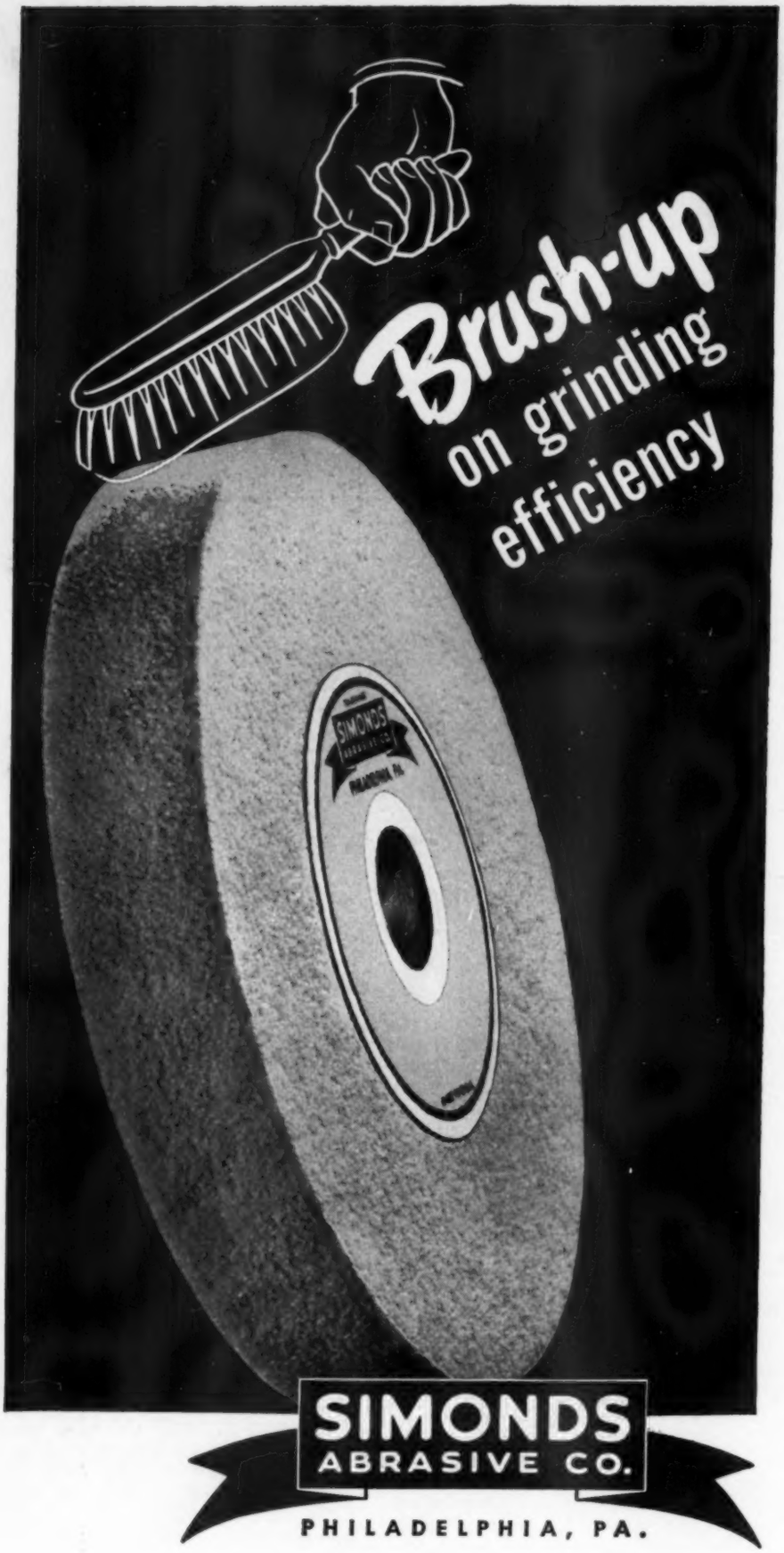
FLARED JOINT. Use only steel flared fittings with steel tubing. Extruded brass fittings are suitable for copper tubing. Place nut over tube. Flare with tool approved by fitting manufacturer. To avoid distortion of fitting wall, insert tubing nut before tightening fitting.

FLEXIBLE HOSE. When there is motion or excessive vibration between two end connections, use hydraulic hose.

Seamless Steel Tubing for Fluid Power Systems

For Flareless Locking-Shoulder Fittings*					For Screwed or Welded Fittings†					
Pipe Size	O.D., in.	Wall Thickness for 1000 psi.	1500 psi.	3000 psi.	Pipe Size	O.D., in.	Wall Thickness	Pipe Size	O.D., in.	Wall Thickness
⅛	¼	0.030	0.030	0.050	⅛	0.405	0.065	1½	1.900	0.219
¼	⅜	0.035	0.035	0.060	¼	0.540	0.119	2	2.375	0.250
⅜	½	0.050	0.050	0.080	⅜	0.675	0.126	2½	2.875	0.313
½	⅝	0.050	0.050	0.095	½	0.840	0.147	3	3.500	0.375
¾	⅞	0.065	0.065	0.135	¾	1.050	0.154	4	4.500	0.500
1	1⅛	0.065	0.080	0.160	1	1.315	0.179	5	5.563	0.625
1¼	1¼	0.065	0.095	0.195	1¼	1.660	0.191	6	6.625	0.750

**Like Ermeto steel fittings—The Weatherhead Co., Cleveland*
†Capacity: ⅛-to 1-in. pipe sizes—to 4000 psi.; for 1¼-to 6-in. pipe sizes—to 3000 psi.



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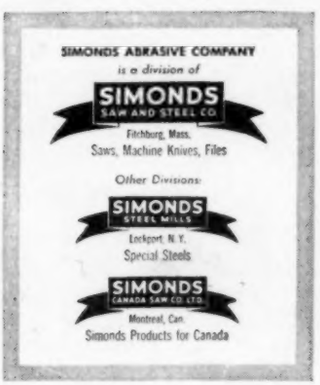
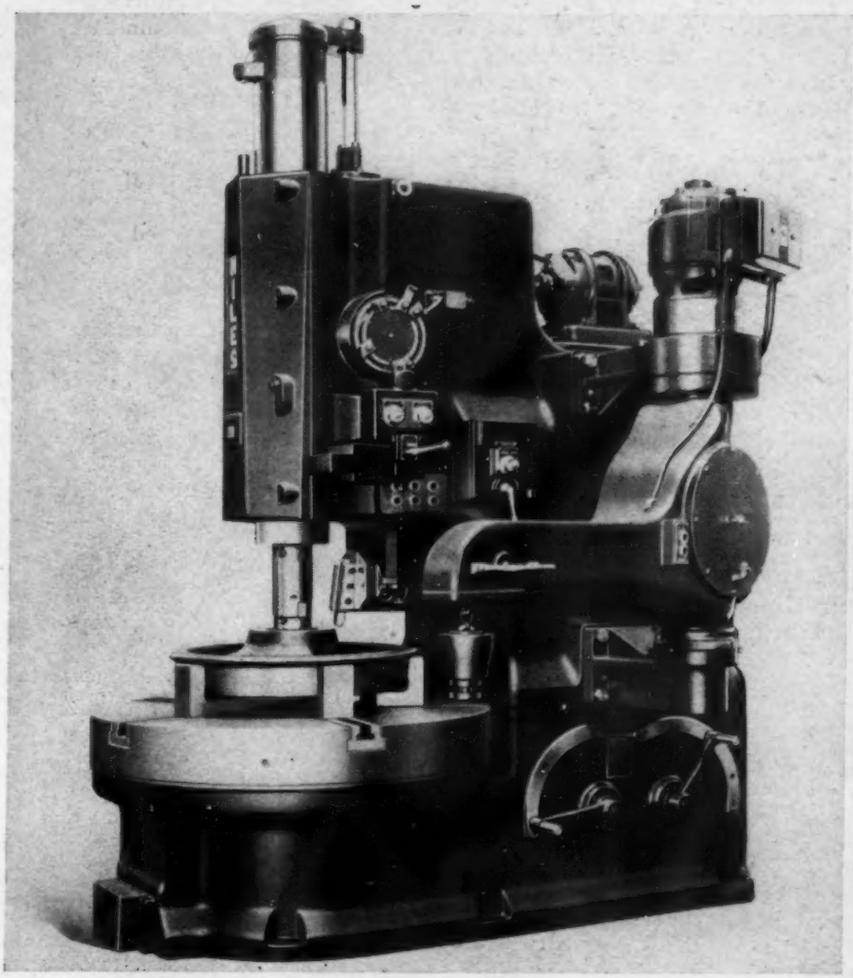


SIMONDS ABRASIVE COMPANY, TACONY & FRALEY STREETS, PHILADELPHIA 37, PA.

Shop Equipment News

Niles 48-in. Automatic Wheel Borer Roughs, Finishes and Chamfers Bore



Three controls start the cycle, which is automatic, in this Niles hydraulic wheel-boring machine

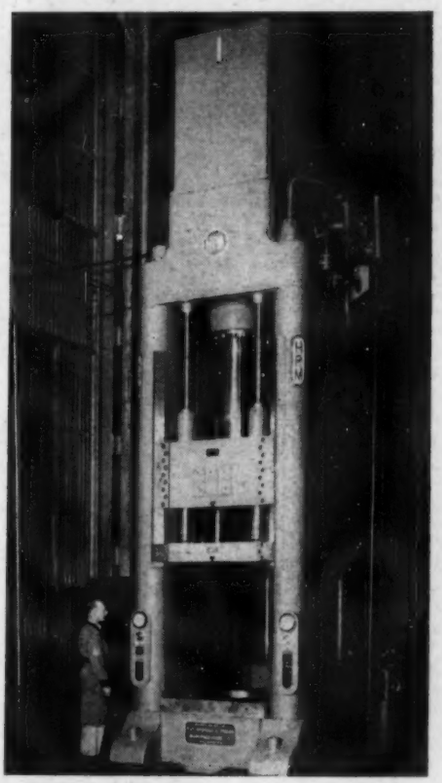
A 48-in. automatic hydraulic wheel borer has been announced by Niles Tool Works Div., General Machinery Corp., Hamilton, Ohio. The unit will be exhibited during the week of June 23 at the Railway Supply Manufacturers' Association Convention in Atlantic City.

The machine has a five-step automatic cycle. Feed dials can be set for most efficient feed for a particular speed and material. Then three separate controls are operated to initiate the cycle. One of the buttons on the control panel is pushed and the wheel is automatically chucked. Another button starts the table. Then a small lever above the panel is pushed down and the boring cycle begins.

The boring ram approaches position to begin the roughing cut and changes from fast traverse to roughing feed. After the roughing cut, the finishing cutters come into position, and the feed changes to proper rate. The feed changes again for the chamfering operation, and an adjustable time delay begins to operate. The boring arm is held against a predetermined positive stop while the chamfer is completed. The main motor is then de-energized, and a brake stops the table. The boring bar returns by fast traverse to starting position, and the table brake is released. All operations are automatic.

Equipment to face the hub of a wheel can be attached to this unit and arranged to have a hydraulic feed and traverse system for the hub-facing ram.

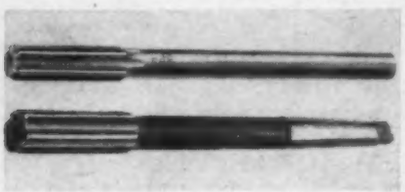
An electric hoist handles wheels on and off the table. The table has six speeds and will chuck wheels as large as 48-in. dia.



HYDRAULIC PRESS — Self-contained 300-ton all-hydraulic press for exceptionally deep drawing has 118-in. opening, 54-in. stroke. Pressing surfaces are 48x48 in., and unit has 125-ton hydraulic blankholder and 84-ton die cushion in bed. Made by Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.

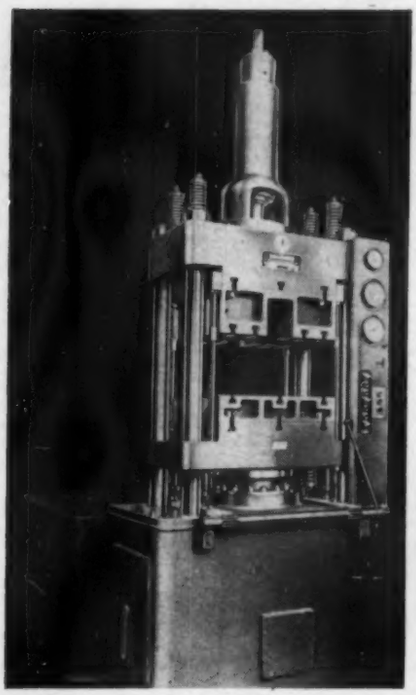
Standard Super Tool Reamers Have Carbide-Tipped Flutes

Standard carbide-tipped reamers with tips running full length of flutes are available from Super Tool Co., 21650 Hoover Rd., Detroit 13, Mich. There are 32 sizes from ¼ to 1½ in.



The long tips serve as wearing guides when operated through bushings, preventing the reamer from freezing up due to galling. Chips are cleared preventing loading in the flute and scoring on the finish.

Baldwin Plunger-Molding Presses Inject, Cure Thermosetting Resins

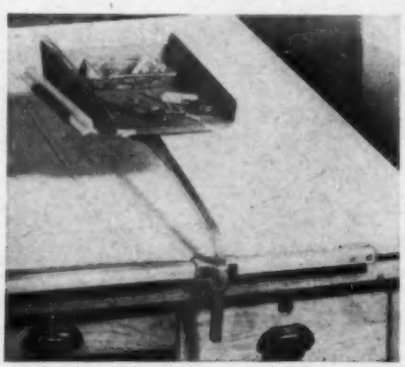


A standard line of Southwark Hy-Speed universal plunger-molding presses is announced by Baldwin Locomotive Works, Philadelphia 42, Pa. The method permits thermosetting resins or soft rubber to be injected into a mold and rapidly cured. Rapid travel of the ram and short cure are said to increase production, increase density and reduce porosity of parts molded.

Ram speed, slow-down, ram tonnage, pull-back tonnage, and ram-return speed are all separately and steplessly adjustable. Dwell and cure periods can be independently set by timers, and separate control of main-ram mold-clamping pressure and top-plunger molding pressure is included. Reduced plunger travel can be obtained when mold does not require its full retraction.

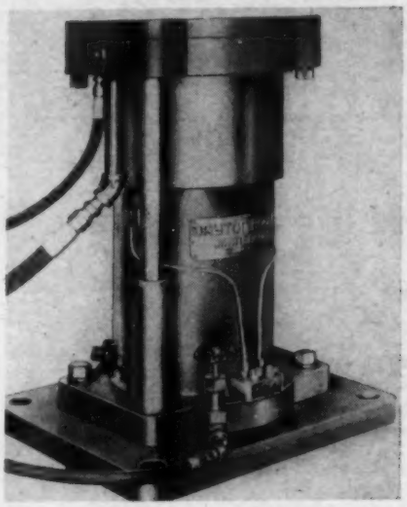
Standard models have capacities of 50, 100, 200, and 300 ton. Die space is from 21x20 to 36x36 in.

Baldwin also manufactures a line of Southwark compression-molding presses which are standard models with custom-built features. Specifications are the same as on the plunger-molding presses, and the units also handle thermoplastic pieces too large for standard injection-molding equipment.



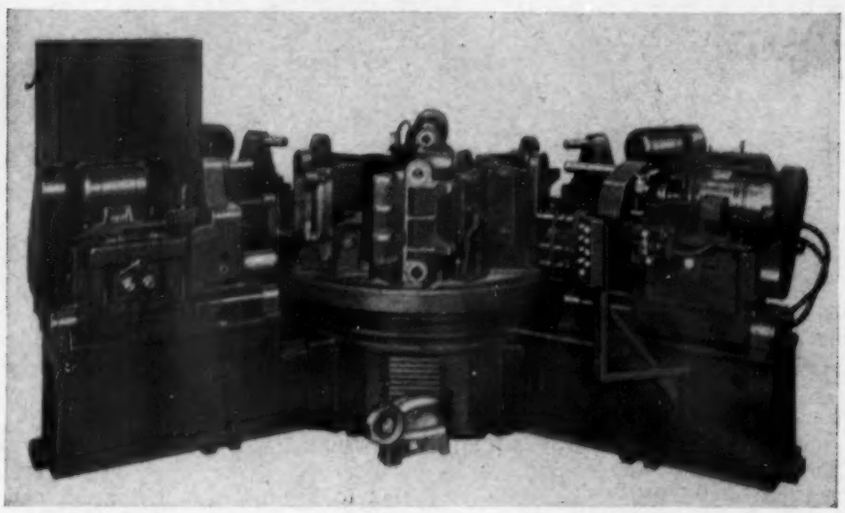
DRAFTING TRAY—Unit moves readily to desired position above working surface. Height and angle are adjustable. Tray is mounted on cadmium-plated bars, holds working tools and accessories. Made by A. Wayne Nunemaker & Associates, 103 S. Wells St., Chicago 6, Ill.

Hydropneumatic Die Cushions Require No Punch-Press Pit



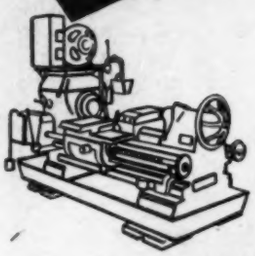
The Model K line of Hydropneumatic die cushions is announced by Dayton Rogers Mfg. Co., 2835 12th Avenue South, Minneapolis 7, Minn. The cushions are built in three sizes with ring-holding pressure from 2½ to 55 ton, developed from 75-lb. shop airline.

The units can be used on inclinable or straight-side presses and have 1- to 10-in. deep-drawing capacity. They are designed with low height so that no punch-press pit is required. Cushions may be used in multiples of two, three or four on all double-crank presses, and each installation is provided with necessary control-valve mechanism including a centralized lubrication system.

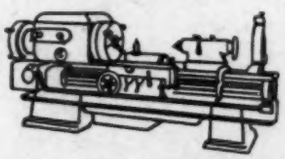


SPECIAL MACHINE—Automatic unit performs 22 operations on cast-iron steering-gear housings. Combines drilling, boring, chamfering, spot-facing, reaming and tapping. Automatic Geneva indexing table has six stations, is electrically driven. Five self-contained units complete one housing per 50 sec. Parts are clamped manually. Made by Snyder Tool & Engineering Co., Detroit 7, Mich.

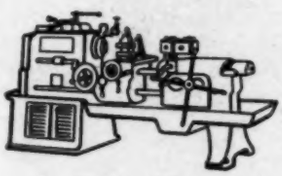
FINE, ACCURATE TOOLING FOR PROFITABLE PRODUCTION



2A and 3A DUOMATIC (automatic) LATHES



HOLLOW SPINDLE LATHES



TURRET LATHES

● "Without the fine, accurate tooling that the Lodge & Shipley Tool Room Lathe permits, we would be severely handicapped out in the shop where production tools take over," says the vice-president of a noted manufacturing firm.*

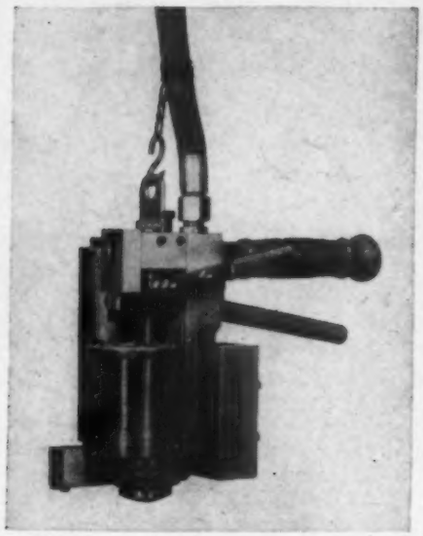
In both tool room and on the production line, Lodge & Shipley Lathes and Turret Lathes earn the unqualified approval of leading firms the country over. Users find the rugged power and split-hair accuracy of these fine lathes indispensable for profitable production . . . unsurpassed for operating ease and minimum maintenance.

"We know what a very fine machine it is," says the same satisfied Lodge & Shipley owner. Let your nearby Lodge & Shipley engineer show you how these modern lathes can do a job on tooling or actual production. Write now for Bulletin 508 (12, 14, and 16 inch Tool Room Lathes) or Condensed Catalog showing the complete line of Lodge & Shipley Lathes.

*Name on request

THE Lodge & Shipley COMPANY
CINCINNATI 25, OHIO
MACHINE TOOL DIVISION • 3035 COLERAIN
SPECIAL PRODUCTS DIVISION • 800 EVANS ST.

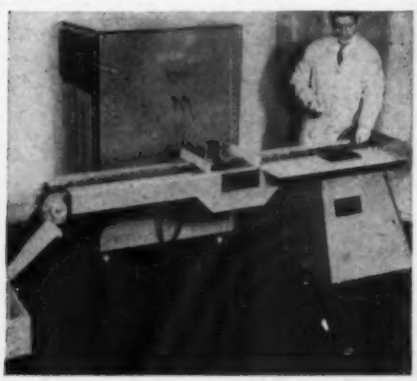
Metaloy Sprayer Metal-Spray Gun Provides Close Control of Amount



A metal-spray gun that melts and sprays low-melting-temperature alloys is made by Metaloy Sprayer Co., 135 Liberty St., New York 6, N. Y. Self-contained, it can be used for intermittent or production spraying. It is designed to provide close control of amount and characteristics of the spray.

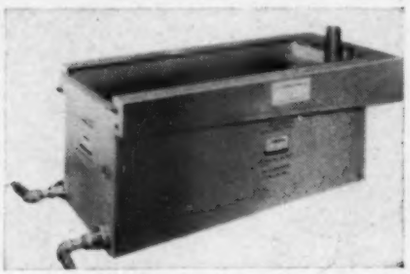
Metal in stick form is inserted through the guide ring and feeds down as it melts. It also can be inserted by ladle and funnel. The design permits intermittent spraying without emptying the pot during off periods. The unit has applications including applying a finely atomized metal surface, coating wood patterns, producing molds, reproducing parts.

Lepel's Conveyor-Belt Table Works with Induction Heaters



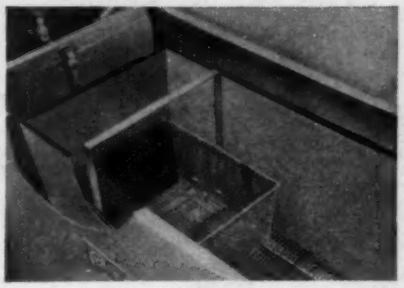
A conveyor-belt table is announced by Lepel High Frequency Laboratories, Inc., 39 W. 60th St., New York 23, N. Y. Used in conjunction with any Lepel high-frequency unit or other make of induction heater, it handles parts for operations such as brazing, annealing, soldering and hardening.

The belt is powered by ¼-hp. motor, and belt speed is variable over wide range. Interchangeable supports permit holding various-shaped work. The load coil can be moved and placed, for example, at left end of belt so that parts are hardened by falling immediately into quenching tank. In the illustrated application, the top edge of a 4-in. long steel wedge is being annealed at a rate of 1800 pieces per hr. A Lepel 15-kw. unit is in the background.



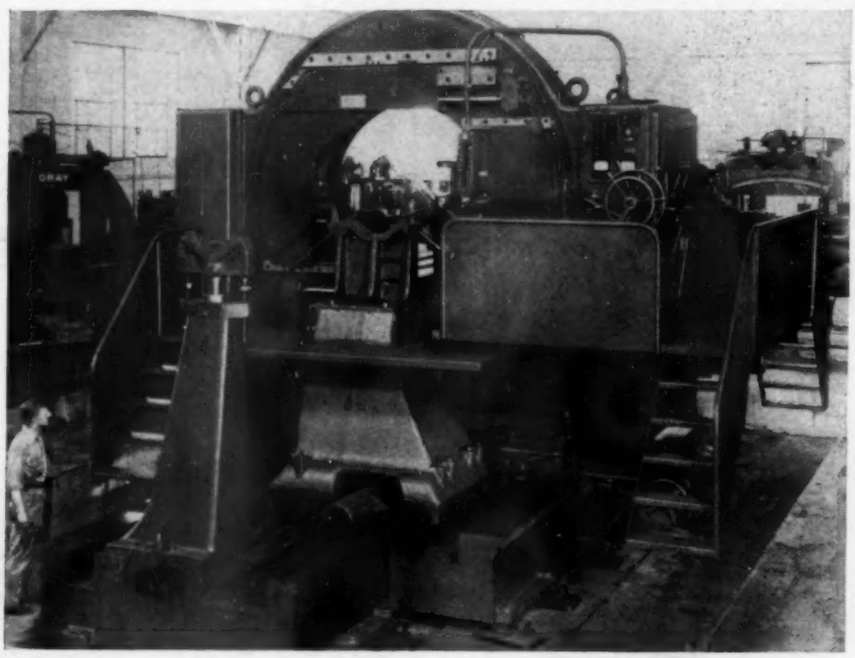
GAS-FIRED TANK—Unit comes equipped with thermometer, drain, overflow connections. It is used for cleaning metal parts and is available in several models. Tanks can be equipped with steam coils where steam heating is desired. Made by D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.

Turco Products Turbulator Tank Removes Oil, Grease and Chips



The Turco Turbulator tank, an automatic multi-flow cold-tank cleaner, is produced by Turco Products, Inc. 6135 S. Central Ave., Los Angeles 1, Calif. For removing oil, grease, chips and other foreign matter that collect on parts during drilling, grinding and similar operations, it is actuated by air volume, pressure differential and gravity. It cleans by liquid scrubbing and solvent action.

Tiny metered orifices release compressed air to induce liquid flow in the inner tank. Turco cleaning compound is forced around parts, cutting film from the surface and depositing particles in a sludge box. Working capacities in the four models range from 52 to 765 gal. Small parts are placed in a wire basket with wide mesh to permit free flow.



CRANKPIN TURNING—Unit machines large diesel and similar crankshafts. Made by Wickes Brothers, Saginaw, Mich., which has taken over manufacture of a line of five sizes of crankpin-turning machines ranging in weight from 27,000 to 240,000 lb., formerly made by Beloit Iron Works. Crankshaft is set up on stanchions, while cutting tools revolve around crankpin

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...with AMERICAN PHILLIPS SCREWS

that keep brakes on costs, protect performance, speed up sales

"STEP ON THE GAS" IN PRODUCTION! Why *put up* with slow, slip-and-slash, "horse-and-buggy" fastening methods when AMERICAN PHILLIPS SCREWS can be driven at TOP SPEED. But speed is only part of the story. American Phillips Screws can't be fumbled, fingers can't be mangled, work can't be wrecked. And driving is automatically straight. So . . . TOTAL TIME-SAVINGS MOUNT AS HIGH AS 50%.

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4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

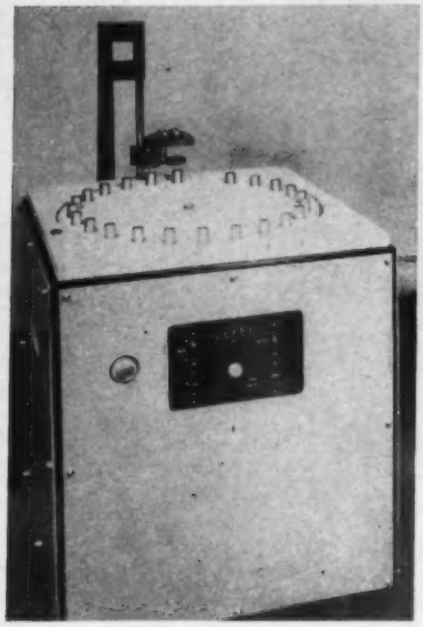
Chicago 11: 589 E. Illinois Street *Detroit 2:* 502 Stephenson Building

AMERICAN PHILLIPS *Screws*

ALL TYPES

ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

Lepel Automatic Indexing Table Heats Small, Irregular Parts



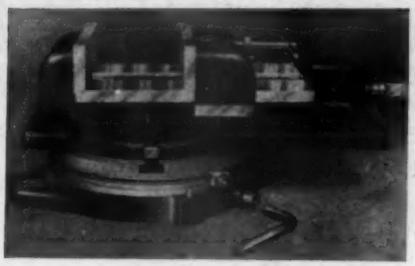
An automatic indexing table for soldering, brazing and annealing round or irregular small parts has been released by Lepel High Frequency Laboratories, Inc., 39 W. 60th St., New York 23, N. Y. The unit is designed to heat parts where shape or control of heat requires closer coupling than can be obtained by moving parts through a tunnel-type coil.

Parts are indexed, the load coil lowers and surrounds the part, and the heating cycle is carried out. The movements are all automatic. Heating-cycle length is varied by an adjustable timer, and index speed is adjusted through a variable-speed drive. Travel up and down of the coil is usually 3½ in. but can be changed. The table can be used in conjunction with any Lepel high-frequency converter or other high-frequency generator.

Kennametal Internal Tools Round Machine-Part Corners

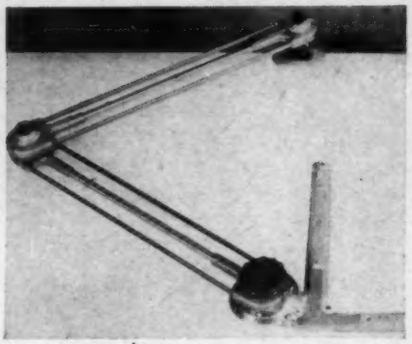
A standard line of internal radius tools and blanks for rounding the corners of machine parts is announced by Kennametal Inc., Latrobe, Pa. Tools are form ground to hold contour when reground on top surface only. The complete tools (Style FR) and blanks (Style R) are for forming 12 sizes of corners from 3/32- to ½-in. radius.

Geco Vise with Rotary Index Base Locks Work with Pressure Screw



The 6-in. Quick-Set vise and rotary index base are made by The Geco, Inc., 30 Grove St., New Canaan, Conn. The vise may be adjusted by lifting the lock handle and shoving the jaw against the work. The moving jaw is locked by ½ turn of the pressure screw at the right. The more the screw is turned, the greater the pressure. Jaws have 7x2 in. area, and the maximum opening of the jaws is 6½ inches.

The 10-in. rotary index base is furnished standard with the vise. It can be used separately for toolroom or production work. An automatic spring-loaded index pin engages the index blocks as the table is rotated. A T-slot through the center locates the vise or other work.



DRAFTING MACHINE—Improved Vemco unit has steel covers to protect bands. Plastic brake plates are replaced by metal plates and new color system is employed. Available from V. & E. Mfg. Co., 758 Fair Oaks Ave., Pasadena, Calif.

Giddings & Lewis Plastics Press Clamps, Injects in Same Stroke

Vertical construction simplifies insert molding on this machine, helping to prevent mold damage, because inserts can be held in position by gravity

A vertical plastics-injection press is manufactured by Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Incorporating a single hydraulic cylinder, the press provides for clamping the mold halves together and injecting the plastic material into the mold cavity in the same stroke of the piston rod.

The piston is powered by a self-contained hydraulic unit integral with the machine. When the cylinder is activated, motion of the piston rod operates a toggle mechanism. The downward movement locks the die plates together, and, as the rod continues, it serves as a plunger to inject thermoplastic material into the mold.

Vertical machines are designed to provide for quick change of the heating cylinders in approximately 20 min. Thus it is practical to have a supply of cylinders for different plastic materials on hand. Controls, which are centralized, permit manual, semi-automatic or automatic operation of the machine, and the aluminum and plastic "full-view" safety gate is automatic.

Revolutionary Production Method

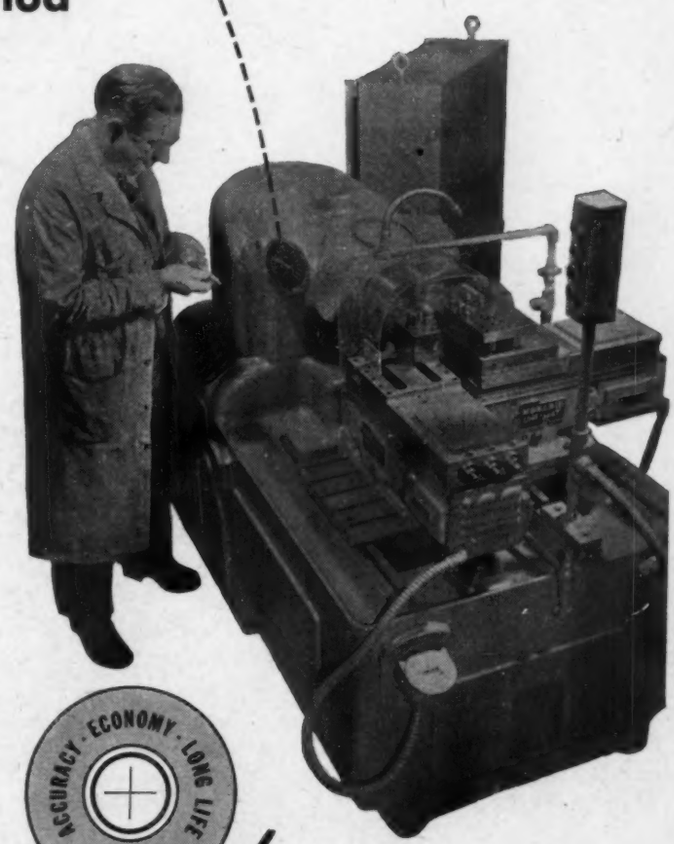
• Spindle speeds up to 3000 rpm—for maximum production on small-diameter work, using carbide-tipped tools.

• Independent motor-driven tool slides (we call them Uni-Mats)—for universally adaptable tooling on repetitive automatic production.

• Completely electric push-button control of all functions—for high-speed metal turning at maximum efficiency.

These are important reasons why the Monarch Uni-Matic is a revolutionary production method—a machine that brings automatic operation within reach of every shop, no matter how large or how small the lots.

Through application of the Uni-Mat principle, every production job can be tooled up to take advantage of multiple tooling, automatic operation, maximum efficiency at high speed—and universal adaptability. For work as small as 1″ and as large as 6″ to 8″ in diameter and larger, the Uni-Matic will give you *peak production at a profit.* Like more details? Ask for Bulletin 1701.



THE MONARCH MACHINE TOOL CO.
Sidney, Ohio

ACCURACY · ECONOMY · LONG LIFE
Monarch
TURNING MACHINES

FOR A GOOD TURN *FASTER* — TURN TO MONARCH

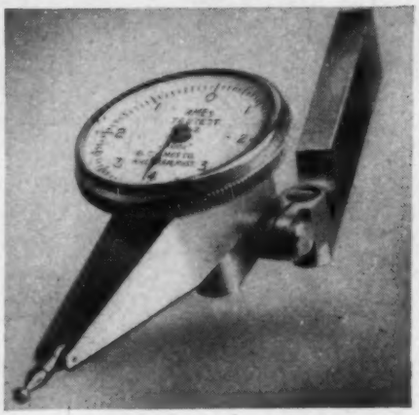
Wilson Hardness-Testing Machine Performs Light and Heavy Work

A heavy-load Model LR "Tukon" hardness-testing machine is announced by Wilson Mechanical Instrument Co., Inc., 230 Park Ave., New York 17, N. Y. For light and heavy testing, it applies loads from 25 to 50,000 grams.

The Long Range model tests with either the Knoop or 136° Diamond Pyramid indenter (Vicker Type). A fast-speed elevating screw is used for adjusting to specimen thickness. A meter indicates when load is being applied to indenter, when the electronic tube is in operating condition and when the test cycle has been completed. The Knoop indenter is for tests from 25 to 3600 or 5000 g. The 136° Diamond Pyramid indenter is used for tests from 25 g. to 50 kg. Loads of 10,000 g. are furnished standard, and loads from 10 to 50 kg. are accessories.

PLYWOOD PALLETS—Unit has 5/8-in. plywood decks and posts of plywood block or metal. It is double faced, designed for 4-way fork entry. Metal posts are furnished for use with hand-lift or motorized pallet trucks. Sizes from 30x40 to 48x60 in. Capacities are 4,000 lb. carrying load, 16,000 lb. static. Made by Clark Trucktractor, Div. Clark Equipment Co., 258 W. Champion St., Battle Creek, Mich.

Trutest Universal Indicator Uses Interchangeable Contacts



The Trutest universal indicator has been released by B. C. Ames Co., Waltham 54, Mass. The unit features automatic reversible action which eliminates tripping of a latch in changing from "over" to "under" work. The indicator hand always moves in a clockwise direction, whether top or bottom of contact point is used.

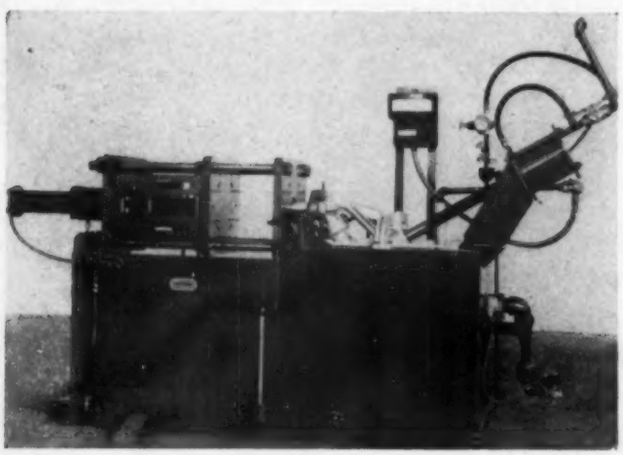
The contact finger swivels to desired angle and maintains position. Two contacts, 0.100- and 0.031-in. dia. are furnished with each model. There are two support bars for tool-post and height-gage work. The two models of the Trutest give respective readings of 0.0005 and 0.0001 in. They have the same outside dimensions and use the same contacts.

Cox Hot-Shot Die-Casting Machine Is Air Operated, Self-Contained

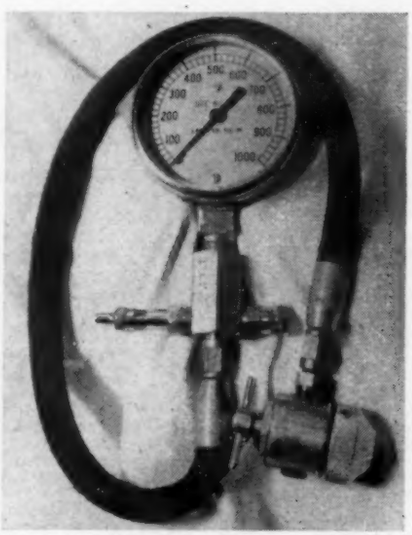
The "Hot-Shot" die-casting machine, manufactured by Robert A. Cox Co., is distributed by Ermac Co., 1426 S. Santa Fe Ave., Los Angeles 21, Calif. A self-contained, air-operated unit, it is designed for intermittent-production die-casting work.

The "Goose-neck" type machine measures 22x72x40 in. high. It has 11x16-in. die capacity and 7-in. die stroke. Up to 720 shots per hr. can be obtained. Die-plate sizes are 16x16 in., and space between bars is 11x11 in.

The unit has single hook-ups for air, gas and 110-v. current. It is furnished with blow torches for heating the goose-neck and loose-type removable nozzle. Standard equipment includes Willco pyrometer, holding furnace, Venturi-type gas burner and Thermo Coupler. Working parts are readily accessible.



The holding pot of this die-casting machine has a capacity for 300 lb. of zinc alloy. Maximum casting capacity is 1½ lb.



AIR GAGE AND HOSE—Assembly used to facilitate charging hydropneumatic accumulators and similar vessels with air under pressure from regular shop line. Bleed valve relieves vessel pressure if gage reading is too high. Made by Greer Hydraulics, Inc., 454 18th St., Brooklyn 15, N. Y.

HONAN-CRANE PURIFICATION OF CUTTING OILS For

Wagner Electric Corporation, St. Louis, PREVENTS OIL WASTE—

INCREASES TOOL LIFE—REDUCES THE INCIDENCE OF DERMATITIS

Three serious problems prompted Wagner Electric Corporation, of St. Louis, Mo., manufacturers of electric motors, transformers, industrial brakes and Lockheed hydraulic brakes and parts, to adopt cutting-oil purification.

They were: Short tool life, dermatitis—and oil waste due to frequent discard and replacement of oil as a control against the first two mentioned.

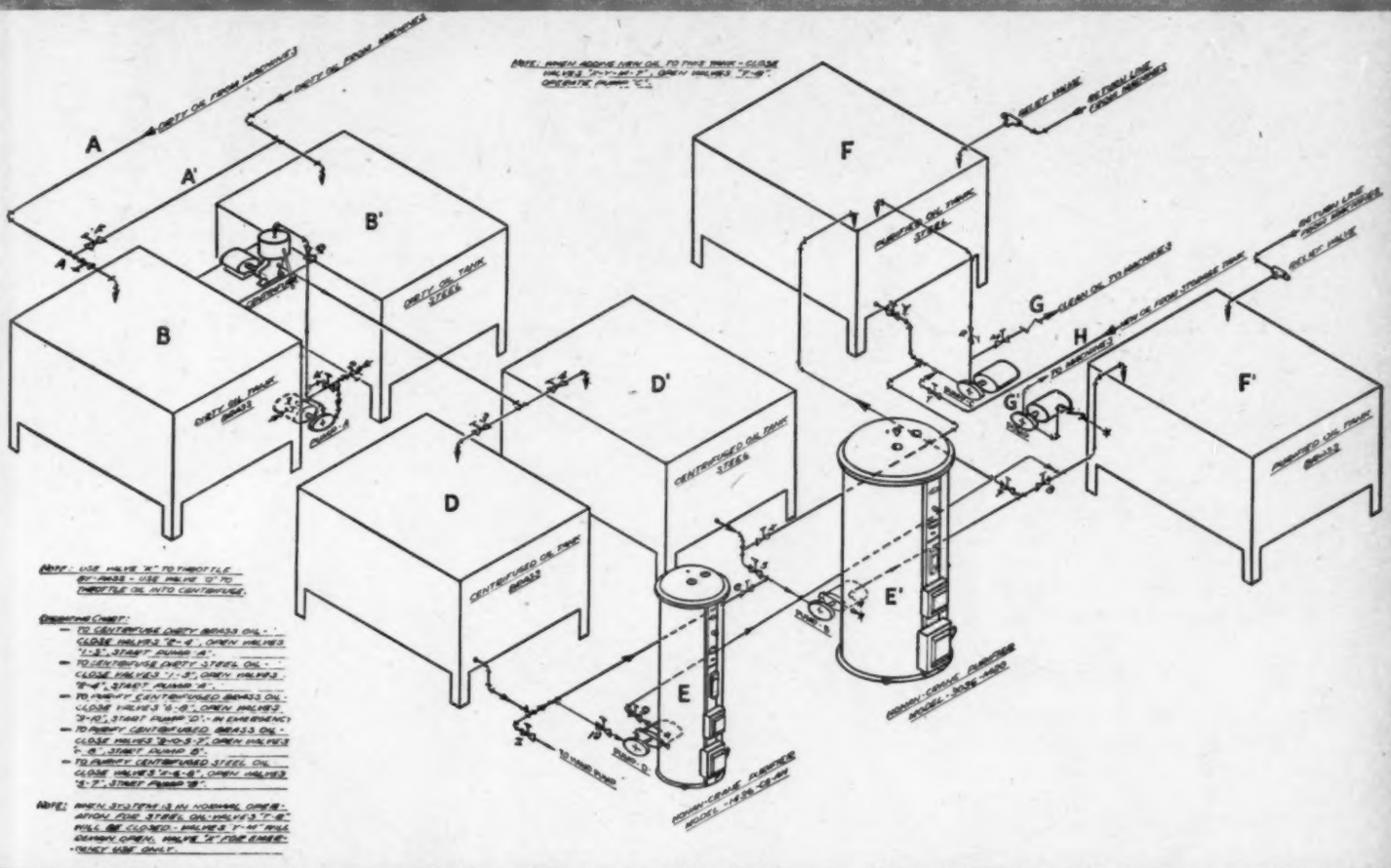
The two departments involved 136 automatic screw machines (Brown & Sharpes, Davenports, New Britains, Conomatics and Gridleys) employed in the machining of brass and steel component parts.

The system charted below, including one Honan-Crane Model 3036M20 Purifier and one Honan-Crane Model 1436C8AH Purifier, was installed. The former processes 1,000 gallons of sulpherized cutting-oil and the latter, 150 gallons of paraffin-base oil daily.

Here is an excerpt from a letter to Honan-Crane Corporation from R. H. Hackett, Wagner Electric Plant Engineer—written after only a few months of operation on clean oil:

"At this writing, we have not had sufficient time to assemble any definite figures on the reduced consumption of oil since the installation of the purifying system, but suffice it to say it is substantial and has more than justified the cost of the equipment. Furthermore, there has been a marked increase in the tooling life of these machines which is directly attributable to using clean, abrasive-free cutting-oil. Also, we are advised by our medical department there has been an appreciable decrease in the incidence of dermatitis in the departments served by this equipment."

May we send you other case histories—and complete information on Honan-Crane Oil Purification equipment? Please fill out and mail the coupon.



Here is a simple diagram of the Wagner Electric Corporation's central cutting-oil purification system. Tanks and purifiers are located in the basement, beneath the automatic screw machine departments. Dirty oil from both steel and brass cutting machines is gravity dropped through lines **A** and **A'** to separate dirty oil tanks **B** and **B'**. It is pumped from these tanks through a centrifuge (only one tank operative at a time) and from the centrifuge to a second pair of tanks, **D** and **D'**. It is then pumped through the purifier, **E** or **E'** and stored in clean oil tanks **F** and **F'** (one for brass cutting-oil and one for steel). Machines are supplied from these clean oil tanks through lines **G** and **G'**. New oil for make-up is pumped directly to clean oil tanks from storage through line **H**. This is a continuous circuit system—with completely adequate capacity—and performance.

Honan-Crane Corporation
205 WABASH AVENUE, LEBANON, INDIANA

☐ Please Have a Sales Engineer Call

☐ Please send me bulletins on cutting oil purification and full information on Honan-Crane Cutting-Oil Purifiers.

NAME_____

COMPANY_____

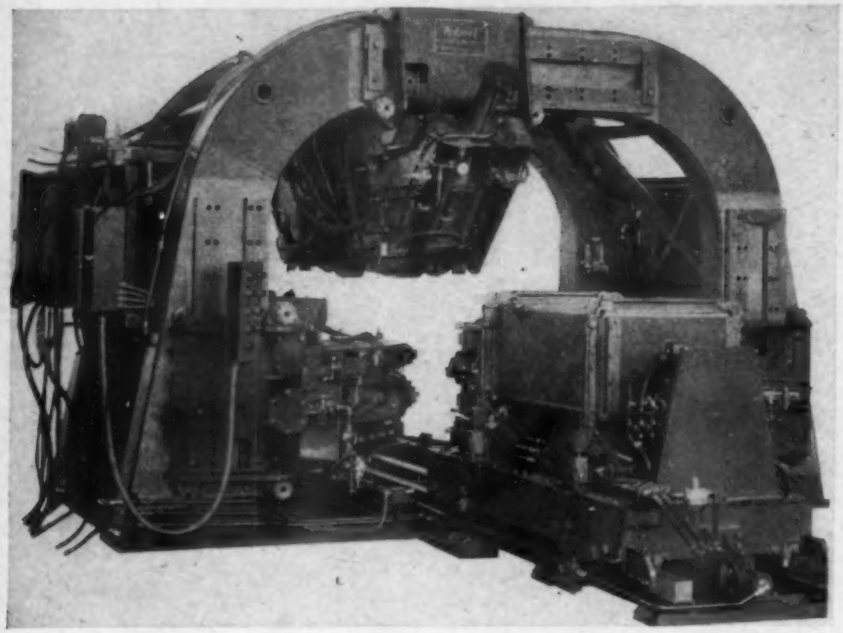
ADDRESS_____

CITY AND STATE_____

A Subsidiary of

HOUDAILLE-HERSHEY CORPORATION

Federal Mash Seam Type Welder Has Three Dual Welding Heads

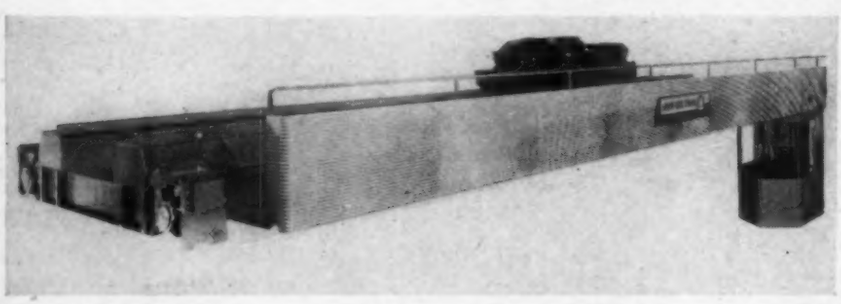


Welding heads are manually adjustable, both vertically and laterally, to accommodate welding of different size refrigerator liners. Limit switches can be set to vary travel length of the welding heads

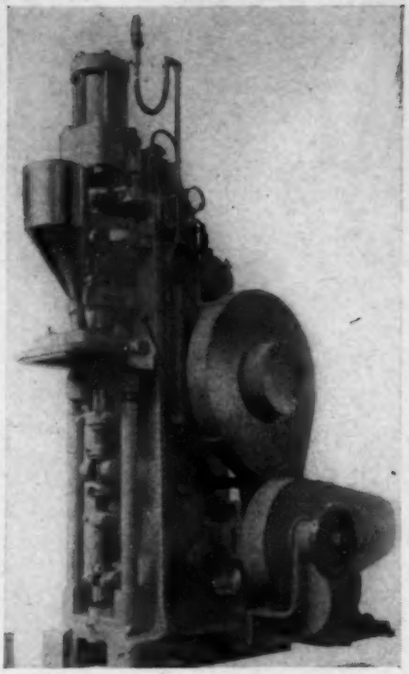
A high-production mash seam welder has been developed by Federal Machine and Welder Co., Warren, Ohio. Known as the Triple Duplex Traveling Head Series seam welder, the unit has three 300-kva. water-cooled welding transformers wired for 440-v., 60-cycle ac. power supply. One transformer is mounted in each of the three dual welding heads and is equipped with a 16-step heat regulator.

The equipment has its own hydraulic system including pumping unit and oil-cooling reservoir for supplying hydraulic fluid under pressure to the welding-head traveling cylinders and fixture-carriage actuating cylinder. Each of the six welding heads has an individual air cylinder for applying weld pressure.

The unit illustrated is constructed to weld food-compartment liners for 7, 8, 9 and 11 cu. ft. model refrigerators. A liner is composed of three parts: the wrapper which forms two sides and the back of the liner, and the top and bottom which are welded to the wrapper ends. The complete welding cycle takes 25½ sec., requiring one operator and one helper for loading and unloading. Liner parts are held in the traveling fixture by air clamps.



STREAMLINED CRANE—10-ton capacity "Shaw-Box" overhead-traveling crane has approximately 55-ft. span, incorporates color-safety painting. Sheathing along platform serves as guard against anything dropping to floor, and design of cage provides high visibility. Built by Shaw-Box Crane & Hoist Div., Manning, Maxwell & Moore, Inc., Muskegon, Mich.



Synchronized movements of upper and lower punches of this press are controlled by independent cams

Stokes Powder-Metals Press Gives 30 Strokes per Min.

The S-3 general-purpose powder-metals press is announced by F. J. Stokes Machine Co., Philadelphia 29, Pa. Similar to the Stokes model S, it has 40-ton capacity and operates at speeds to 30 strokes per min.

The press is an automatic cam-operated unit in which independent cams control synchronized movements of both upper and lower punches. The compound lower punch can operate either as a secondary lower punch or as a movable core rod. It can be locked in place to serve as a stationary core rod, if desired.

The upper punch is timed to remain out of the way for more than 110° of cycle. It descends rapidly, then slowly compresses the metal powder. The movement facilitates feeding of difficult materials and is said to be essential in making thin-wall parts. The cams can be set to control each punch movement within a wide range.

Maximum die fill is 6¼ in. and maximum diameter that can be pressed is 3 in. The unit is equipped with variable-speed drive and a fast-acting lever-operated combined brake and clutch. It produces 10 to 30 pieces per min. The drive motor is 7½ hp. and the machine weighs 12,000 lb.

RUST PREVENTION

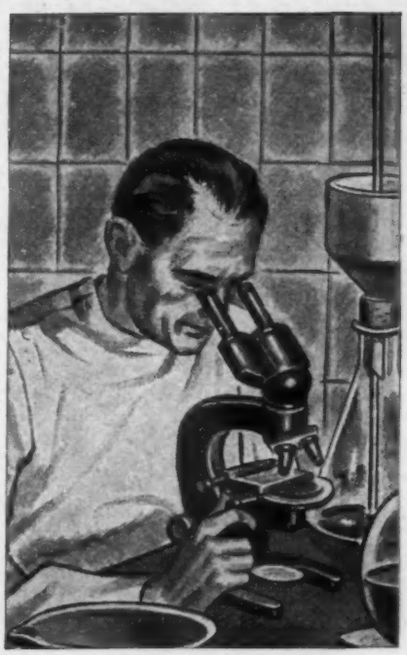
$100,000 Worth of Hand Tools saved from "RUST"

NEW PRODUCT DOES THE JOB AFTER PLANT CONDUCTS EXHAUSTIVE TESTS

"Some time ago, we were called in by a prominent manufacturer.* Corrosion of all metal parts in his entire plant had gone out of control. The machine shop and hand tools, valued in excess of $100,000, were a sorry looking 'dusty-brown.' Everything they had used in the way of rust preventives heretofore failed to solve their difficulty.

Lubrication Engineer's Report

"After studying their problem we recommended our General Purpose Anti-Corrode No. 100 and suggested that they give it exhaustive tests. Their chemist did so and we are happy to report that it solved their problem.



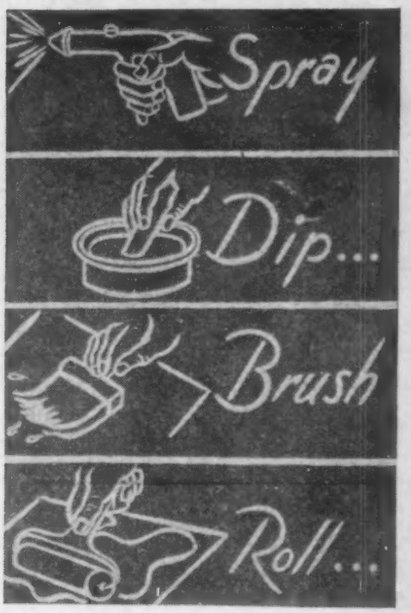
Used on Hand Tools As Well

"They have since used over 150 gallons of this Anti-Corrode on everything metal in their plant, including small hand tools such as pliers and screw drivers."

Anti-Corrode No. 100 is one of several new types of Cities Service protective coatings for metals. Designed to prevent corrosion of raw stocks, finished parts and completed machines, it adheres firmly, displaces moisture and protects longer than many materials now on the market.

Easy To Apply

Apply Anti-Corrode by ordinary work-shop methods. Spray, dip, brush or roll it on. The protective film is continuous and non-porous—does not break at sharp edges nor rupture on flat surfaces. It need not be removed from metal to be stamped, drawn or otherwise formed.



Write For Demonstration

Cities Service will demonstrate the many advantages of Anti-Corrode to you in your own plant. Contact the branch office nearest you or write Cities Service Oil Co., 60 Wall Tower, New York 5, N. Y.

**Name on request*

Cities Service means Great Service

CITIES SERVICE

Cities Service Oil Co. NEW YORK · CHICAGO

Arkansas Fuel Oil Co. SHREVEPORT, LA.

(This offer available only in Cities Service marketing territories East of the Rockies.)

CITIES SERVICE OIL COMPANY
SIXTY WALL TOWER
NEW YORK 5, N. Y., ROOM 100

Gentlemen: I'd like to test ANTI-CORRODE No. 100 on my own equipment FREE OF CHARGE. Send me details.

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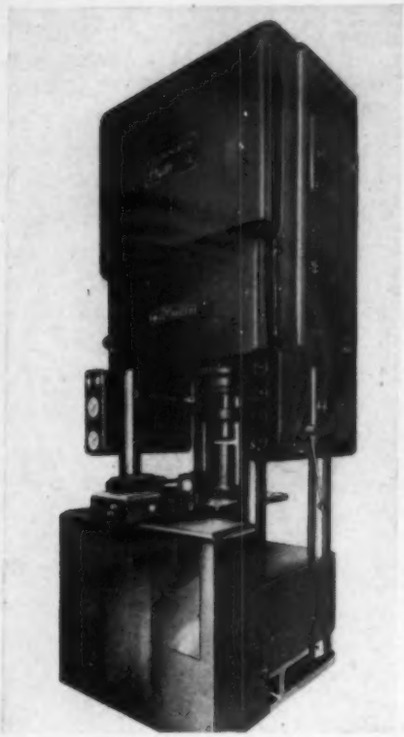
Denison 75-Ton Multipress Provides Vibratory Control



The 75-ton Multipress, companion machine to the original small bench-size unit, is announced by The Denison Engineering Co., 1160 Dublin Rd., Columbus 16, Ohio. Incorporating the Vibratory Control feature, the 4-strain-rod press gives pressure variance from 7½ to 75 ton.

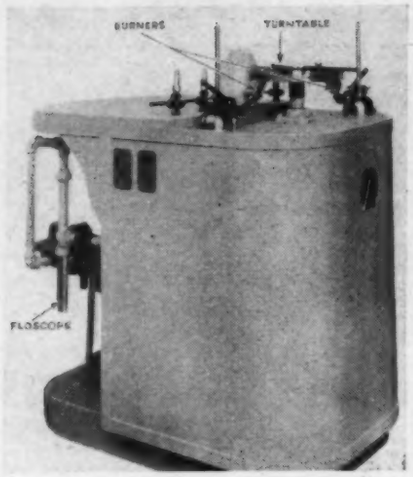
There is a choice of three valve combinations to vary pressing cycle. Features include: automatic or manual ram cycling; fast traverse with slow pressing speed; pressure and distance reversal; low ram tonnage if desired with high return and accessory pressures; one-man operation; pressurized filter system; and gages, controls and adjustments at fingertip. Stroke is 18 in. and daylight opening is 30 in.

Yankee Electronic Gagehead Has Only One Moving Member

An electronic gagehead, the Multiple Lightronic, is announced by Yankee Precision Products Co., 50 Bartholomew Ave., Hartford 6, Conn. The unit has up to 14 stations, is self-contained, and operates direct from 110-v., 60-cycle, single-phase current without using an electronic control cabinet.

Each station is recorded by lights and has an adjustment for tolerance setting. Accuracy of setting between lights is said to be 0.000005 in., and tolerance range between high and low is 0.015 in. The only moving member is a gage spindle which operates all lights. The unit is designed for selective assembly inspection and for automatic selective-gaging units.

Selas Gas Heat-Treating Table Operates at Production Speeds



A heat-treat table for annealing, hardening, silver-brazing, soft soldering and other heat-treating operations at production speeds is made by Selas Corp. of America, Philadelphia 34, Pa. A revolving variable-speed jig table is incorporated to handle work of various sizes and shapes.

Two Superheat burners, having a turn-down ratio of 40:1, can be adjusted to any position. Additional or different burners can be supplied. Gas and air pass through Floscopes (visual flowmeters) to a Selas Combustion Controller so that required proportions and pressures are maintained. The mixture line is guarded by an automatic fire check.

Zagar Hydraulic Broaching Machine Gives 36-in. Stroke, Fast Return

Double cylinders spread the pulling stress to provide smooth operation. The machine is designed to prevent chip interference or oil splashing

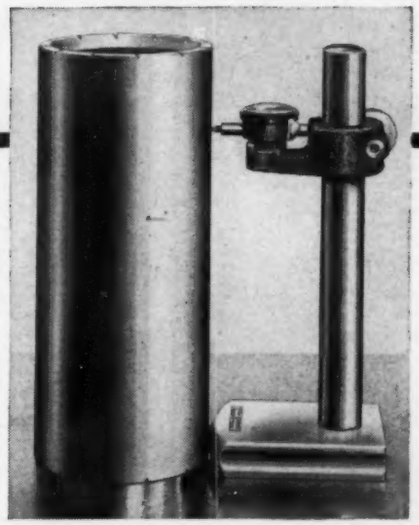
A double-cylinder 36-in. stroke hydraulic broaching machine is available from Zagar Tool, Inc., 23880 Lakeland Blvd., Cleveland 17, Ohio. The unit is designed so that two jobs can be set up at one time. One is worked and the other is left in readiness.

An oil control valve is said to permit extremely slow ram speeds without pulling-power loss. Return stroke is fast. Pulling power is 16,000 lb. Speed selection is through controls on the recessed instrument panel.

The unit is equipped with 220/440-v., 3-phase, 60-cycle motor. It is constructed to save floor space and yet provide ample room for the operator. A Cuno oil filter is incorporated in the system to prevent valve clogging.

New

TAFT-PEIRCE
Comparator Square



✓ No Need for Feelers **✓ No Guesswork by Sighting**

In our own production and inspection departments, this new precision tool is used to advantage constantly . . . as a master for checking squareness.

Providing a positive and *measured* index of squareness error, this T-P Comparator Square also saves wear and tear on surface plates—and on personnel, too, since there's no more need to wrestle heavy pieces into position for sighting.

Large dial indicator registers instantly, plus or minus, to .0001″. Spherical contact-radius on base permits wide range of alignment.

And there's a quick adjustment for height. Operation requires no special skill — nor is there anything to get out of line or require replacement. Delivery from stock. Write for circular and prices. The Taft-Peirce Mfg. Co., Woonsocket, R. I.

IN TOOLING, SET-UP AND INSPECTION
T-P *means* TOP PRECISION

Despatch Plastic Preheating Ovens Use Moist Convection-Heat Process

Each drawer of this plastic preheat oven accommodates 18 3-oz. preforms. Total load is over 40 lb. The charges are used for transfer molding of two complete toilet seats

The "Hydro-Therm" line of ovens is announced by Despatch Oven Co., 619 8th St. S. E., Minneapolis, Minn. For preheating plastics by moist convection-heat process, the ovens are electrically heated drawer-type units, have automatic heat controls and will accommodate up to 50 lb. of preforms per charge. They are available with 4, 6, 9 and 12 drawers.

The ovens permit addition of moisture to molding powders during the preheat process. The moisture is said to give the recirculated air a higher heat content, to prevent precuring while preforms are in oven and to speed actual cure in the mold. Moisture absorbed in the plastic material is said to act as a lubricant, permitting easier flow, faster transfer and less pressure in the press. A built-in steam injector at the base of the oven admits the moisture. It is controlled by needle valve.

Operating range is to 400 F. The ovens may be connected to shop steam line and operate on 100- or 220-v. single-phase 60-cycle ac.

"Washed Air" Polishing Lathe Contains Dust-Collecting System

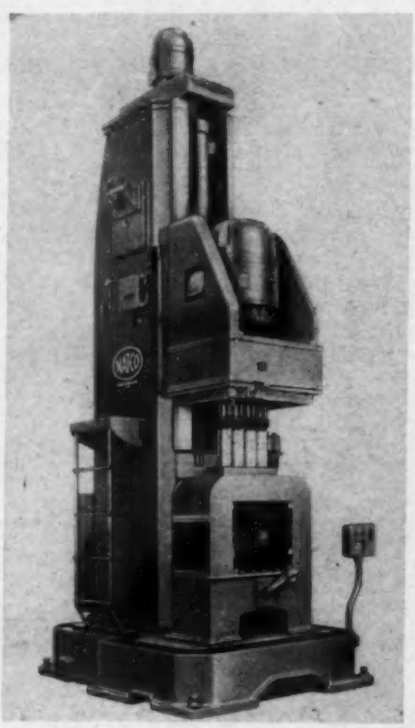
The Model 400, first of a line of polishing lathes for jewelers and other users, is distributed by Ralph Hochman & Co., 52 Edison Pl., Newark 2, N. J. The "Washed Air" line will have five units of various sizes and types.

The unit has a self-contained dust-collecting system. Dust is drawn from the machine surface by 4-in. ducts. Air is cleansed by water and returned by louvers in each side of the collector, and the large amount of dust collected is said to provide a high percentage of salvage of pulverized matter. Various sizes of ball-bearing 1725-rpm. motors from ½ to 3 hp. are available.

Cochrane-Bly Metal-Sawing Unit Has 2-in. Dia. Stock Capacity

The No. 22 metal-sawing machine for ferrous and non-ferrous metals and plastics is announced by Cochrane-Bly Co., 3 St. James St., Rochester 6, N. Y. With a standard capacity for stock to 2-in. dia., it is available in automatic, semi-automatic and hand-operated models. Stock-gage capacity is 9 in.

The standard 12-in. blade can have a single speed to suit a specific application or speed that is variable in one or two steps. Feed is variable in all three types. The vise is attached to the knee by dowels and a machined ledge. It is constructed without a removable jaw so that the load caused by the blade cutting through the material will clamp the work against a rigid part of the machine and eliminate the effect of insufficient clamping. The design of the unit is flexible to permit increased sizes and capacities.



VERTICAL MACHINE—Natco Holesteel for cylinder-boring of replaceable sleeve liners is arranged with hydraulic feed, fixed-center gear-driven head with four spindles. Unit handles cast-iron cylinder and crankcase at rate of 28 parts per hr. Rough and finish bores four cylinders, then counterbores. Utilizes jump feed to rough and finish bore and chamfer lower holes. Made by National Automatic Tool Co., Inc., Richmond, Ind.

Where Robust Rollers Count

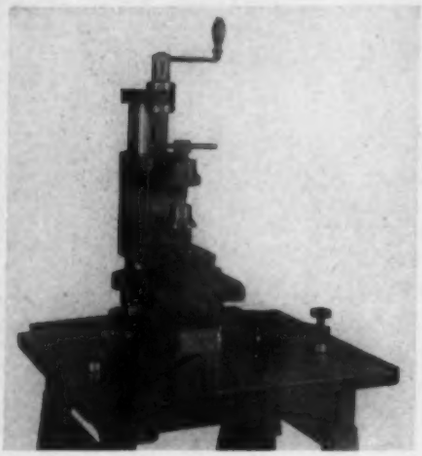
Carrying the loads as they reduce friction—improving performance while they prolong machine life—increasing efficiency and decreasing maintenance—all of these advantages go with the application of Hyatt Roller Bearings.

Builders of better machinery and equipment in the automotive, agricultural, industrial and transportation fields have known the dependability of Hyatt precision and performance for more than half a century. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT

ROLLER BEARINGS

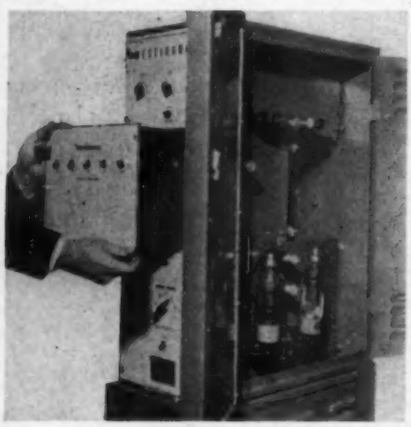
Producto Punch-Holder Remover Separates Dies, Pulls Punches



A punch-holder remover is announced by The Producto Machine Co., Bridgeport 1, Conn. It is used to remove punch holders from die beds and to separate dies by taking the punch out of the die. It can also be used for shearing-in small punches and for general utility.

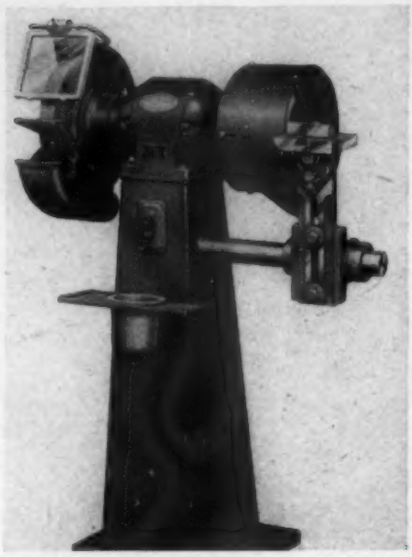
The unit is arranged to clamp a movable holder about the shank of the punch holder and then lift it off the liner pins and the punch out of the die. If there is no shank on the holder, the unit grips the punch holder proper by screwing down an auxiliary screw.

Westinghouse Weld-O-Timers Control Resistance Welders



A line of nonsynchronous packaged ac. resistance-welding controls is available from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. Known as Weld-O-Timer, the units are made in two frame sizes, the 1200 and 600. They make possible hundreds of sequencing and timing combinations, and include four factory-wired subassemblies and two supplementary subassemblies.

The units may be side-mounted, floor-mounted, or mounted away from the welder with adjustment controls at the welder. A transparent access door in the 1200 and a metal door in the 600 protect control setting. Subassemblies may be inspected in both models through a front access door. A subassembly may be removed by loosening two nuts, disconnecting plug connectors and lifting it out.

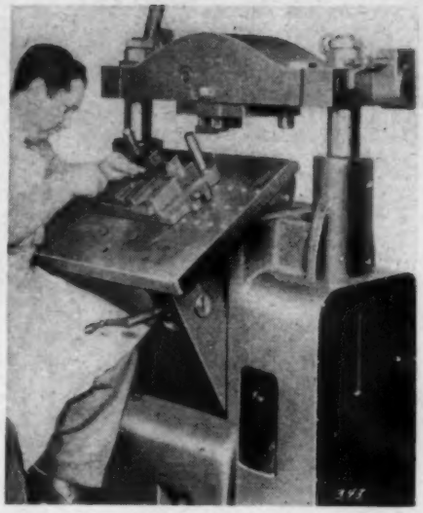


TOOL GRINDER—Model 260 grinds carbide tools, is equipped with grinder for rough work on left and mounts cup wheel on right for finish grinding. Worktable adjusts to desired angle, height, and for wheel wear. Guards have exhaust connections. Motor is totally inclosed. Made by Bradford Machine Tool Co., Cincinnati 4, Ohio

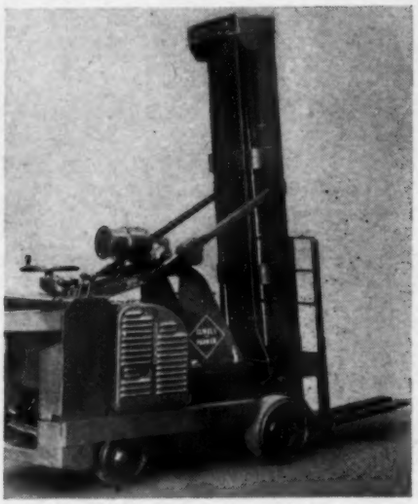
Alpha Model 40 Tryout Press Tries Dies, Speeds Finishing

The Model 40 tryout press is announced by Alpha Tool Works, 6416 Beechton, Detroit 10, Mich. The unit is designed to try dies under actual production conditions and to speed up finishing and make it more accurate. The press can also be used for production to bring to light necessary corrections otherwise difficult to detect.

Finishing work can be performed on male and female members without removing them from the press. Positioning and locking pins retract with a crank, permitting both bolster and head to tilt, making die readily accessible.



With 40-ton capacity, the press has 3¾-in. stroke, 100 strokes per min., 8-in. maximum and 6-in. minimum shut height, and 27-in. clearance between columns.



FORK TRUCK—Unit has elevating reach to 18 ft. above floor level. Capacity is 4000 lb. up to 11 ft. and 3000 lb. to 18 ft. Body is 7 ft. 8 in. long. Truck driven electrically by three motors; one for traveling, one for elevating, and one for tilting the upright column. Made by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 14, Ohio. Standard models previously had a lifting range to 10 or 12 ft.

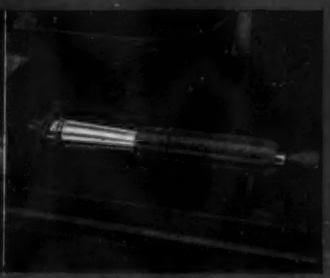
Correction: In describing the Minute Man keyway-broach kit (*AM*, April 24, p. 152) it was stated that the selected bushing is dropped into the bore of the arbor press. This should, of course, have said that the bushing is dropped into the bore of the work in which a keyway is to be cut. The kit is made by The du Mont Corp., Greenfield, Mass.

"KNOCK-OUT" EXPANDING MANDRELS

Fast — Positive — Accurate . . . Save machine time, reduce operator fatigue, eliminate special mandrels. Ideal for all turning and grinding operations. Sizes to handle from 3/8" hole to 5 1/2" hole.

Production turning 45° on 11 lb. casting held on M46 Expanding Mandrel.

Turning small piece in tool room. I. D. 15/32" held on MO Expanding Mandrel.



Production grinding 45° angle holding .001" concentricity. Using M3 Expanding Mandrel.

"KNOCK-OUT" CHUCKS

The tougher the job the tighter it grabs the tool. This self activating chuck eliminates slipping . . . marred and bent shanks. Yet it can *always* be loosened by hand. Saves Time —Reduces Tool Costs.

Ask your nearest supplier or mail the coupon today!

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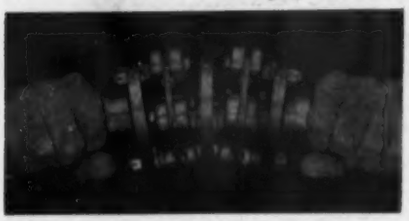
Parts and Materials

Morse Double Morflex Couplings Accommodate Shaft Misalignment



Double Morflex couplings are made by Morse Chain Co., Detroit 8, Mich. A universal-joint type, each coupling consists of two single couplings with a center-plate adapter. The model has twice the torsional resilience of the single coupling. It acts as a universal drive connection and accommodates offset and angular shaft misalignment.

Torsional resilience is obtained through preloaded neoprene-biscuit construction. There is no metal-to-metal contact, and the unit permits constant velocity between driving and driven member. The double coupling is available in 10 sizes from 13 to 725 ft. lb. torque.

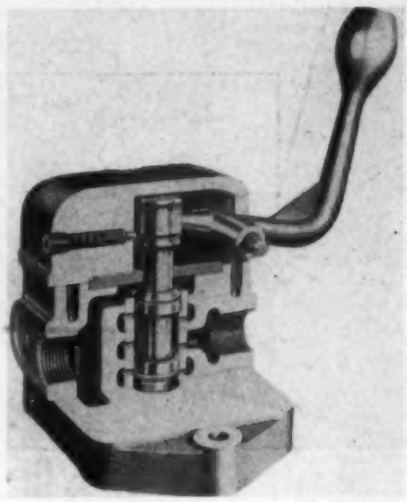
Hardalloy Arc-Welding Electrode Gives Highly Resistant Deposit

Hardalloy, a dc. reverse-polarity, arc-welding electrode for providing deposits which are highly resistant to impact or abrasive wear in hard-surfacing operations, is announced by The McKay Co., 1005 Liberty Ave., Pittsburgh 22, Pa. The deposited metal is said to have 59C Rockwell hardness and to be capable of being heat-treated for machining and grinding, and then re-heat-treated to restore hardness. There are five sizes from 3/32 to ¼ in.

Pennsalt MC-1 Inorganic Cleaner Used for General-Purpose Work

Pennsalt MC-1 general-purpose inorganic cleaner is announced by Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia 7, Pa. A dry, granular material that dissolves quickly in water, it has industrial uses including steam-gun cleaning of painted or unpainted surfaces, tumble-barrel cleaning, burnishing or de-burring, and for metal preparation where a heavy-duty cleaner would be too strong. It is said to harm neither skin nor clothing. 2 to 4 lb. of the cleaner is adequate for 50- or 55- gal. tank of a vapor-spray machine.

Pressure on Pistons Is Balanced In Logansport Air-Control Valves



Complete redesign of their line of air-control valves is announced by Logansport Machine Co., Inc., 905 Center Ave., Logansport, Ind. The balanced construction produces equal pressure on both sides of the piston. Valve seats and rod packing are eliminated. The light weight of the pistons permits high-speed operation and rapid reversal.

The new valves are available in 79 standard models, including direct- and remote-control models. Direct operation can be manual or by dog or cam trips. Remote operation can be by solenoid, by bleeder valves, or by pilot pressure.

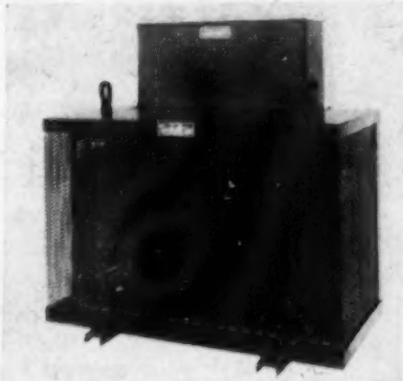
On the hand-operated valves the top cover can be rotated to place the handle in any of four positions at 90° intervals. Illustrated is a vertical piston-type valve available for hand, foot, cam and electric operation. All valves in the line are designed for pressures to 150 psi. Manual-, cam-, and electric-operated valves may be foot or manifold mounted. Manual valves may also be flange mounted.

Magnus Diamond-Grit Compounds Made in Colored Sticks, Paste

A technique for the application of diamond grit to the full range of finishing operations where this polishing medium is used has been developed by Industrial Processing Div., Dept. AM-1, Magnus Chemical Co., Inc., Garwood, N. J. The method utilizes colored, pre-mixed diamond compounds available in paste or stick form. The paste comes in a tube, and the stick has approximately the consistency of lipstick. Color permits instant identification. Eight colors or grades are available in particle sizes from 120 to approximately 1 micron.

Alsoco Corp. Aluminum Solder Bonds without Flux, Substitute

Alsoco, an aluminum solder developed in Switzerland, is manufactured and distributed by Alsoco Corp., 10 E. 52nd St., New York, N. Y. Said to have high corrosion, electrical and vibration resistance, it will solder aluminum to aluminum or copper without flux or flux substitute. It is made in three grades.



TRANSFORMERS—Air cooled units for use with electric furnaces, for testing and applications requiring heavy current. Different sizes rated from 1 to 100 kva.; up to 600 v.; single, 3, or 3-to-2 phase. Have built-in wiring compartment and terminal board. Tap switches to handle 500 amp. available. Made by Transformer Div., Lindberg Engineering Co., 2444 W. Hubbard St., Chicago 12, Ill.

WIDE RANGE OF STANDARD LOW PRICED CARBOLOY BLANKS AVAILABLE FROM STOCK

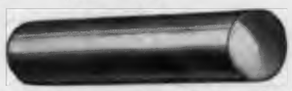
GENERAL PURPOSE CARBOLOY BLANKS

From 60% to 80% of your single point turning, facing, boring jobs can be done with 5 styles of these standards.

SPECIAL PURPOSE CARBOLOY BLANKS

Standard reamer, scraper and lathe center blanks offer maximum economy for these special uses.

SOLID CARBOLOY CYLINDERS (GROUND)

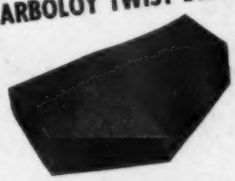


Adaptable to solid boring tools, tool bits and wear resistant uses, a stock of these solid Carboloy cylinders in your tool crib will provide for many uses.

SOLID CARBOLOY ROD (UNGROUND)

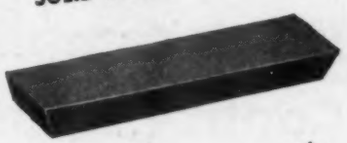
Stocked in 15 diameters from 1/64" to 3/8" in random lengths from 4" to 12". Priced as low as 12c per inch. Excellent for wear resistant uses.

CARBOLOY TWIST DRILL TIPS



For economical drilling of cast iron and non-ferrous metals. Priced from 15c up. Wide range of sizes. Immediate deliveries.

SOLID FACE MILL BLADES



Blades ground on three sides ready for use, with clearance angles formed (not ground) on both ends, for either right or left hand cutters.

SOLID GROUND BALLS

For long economical life on sizing and burnishing operations. Also used in check valves. Sizes 1/8" to 1".

SOLID GUIDE RINGS

For use as a guide for textiles, wire, and similar wear-resistant applications. Now widely used on better fish rods.

BLANKS FOR THREADING TOOLS

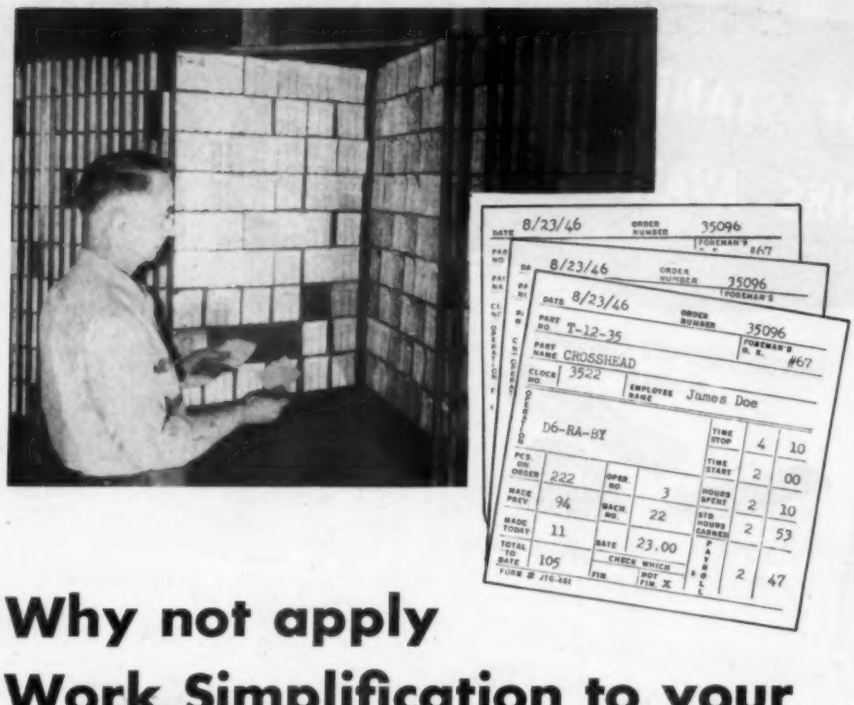
Stocked for use in tool sizes 3/8", 1/2", 5/8", 3/4". Priced 26c to $1.00. Standard in Grade 78B.

Low priced standard Carboloy Blanks are available to you not only for lathe-tool use but also to cover diversified range of other cutting and non-cutting applications, as illustrated above. Prices and specifications of recently announced new blanks, as well as revised prices and specifications on a number of previously established standards, are contained in our recently published catalog supplement GT-199. Copies gladly mailed upon request. Carboloy Company, Inc., 11107 E. 8 Mile Ave., Detroit 32, Michigan.

Carboloy Tool Catalog
Send for Supplement GT-199

Standards are stocked in 74 cities coast-to-coast

CARBOLOY (REG. U.S. PAT OFF.) **CEMENTED CARBIDES**



Why not apply Work Simplification to your Control Systems, too?

Compare the use of McCaskey multiple copy forms and "visible-filing" for Production Control, Payroll and Cost records with the usual posted procedures. The difference in essential operations shown by a simple flow chart is most revealing. McCaskey eliminates numerous handling and posting operations. The advantages of visible records, immediately available, also add savings in both handling and time.

Barrett-Cravens Company, Chicago, made such a comparison in 1943 and adopted McCaskey for individual controls of special production orders and stock parts. A few of the important facts they secure, for example, with *only one writing* of their McCaskey triplicate time tickets are:

(1) Status of every production order, special or stock, visualized within minutes after the completion of an operation;

(2) Operation cost data immediately available for analysis and investigation of variations;

(3) Accurate, up-to-the-minute data reduce dependence on stock chasers;

(4) Incentive pay-roll records checked and quantity count verified;

(5) Verified record of production for operators on incentive work, preventing disputes and dissatisfaction.

Write for a demonstration and suggestions for an application to your particular needs—or send for a copy of "The ABC's of Production Control" and other descriptive folders.

McCaskey INDUSTRIAL CONTROLS

PRODUCTION • INVENTORY • TOOLS • COSTS • PAYROLL

THE McCASKEY REGISTER COMPANY, ALLIANCE, OHIO

McCaskey Systems Ltd., Galt, Canada — The McCaskey Register Co., Watford, England

All-State No. 7 Solder Rod Repairs Cracks in Cast Iron

No. 7 cast-iron solder rod is available from All-State Welding Alloys Co., Inc., 96 W. Post Rd., White Plains, N. Y. Said to produce corrosion-resistant welds, it is used for jobs such as repairing cracks in cast iron which must be water- and pressure-tight against pressures to 1000 psi. It is also used for jobs where strength is not required. Melting temperature is 600 F., and All-State No. 7 flux is used, except when brazing dissimilar metals to aluminum, when No. 53 flux is used.

NYLON CABLE—Cable available from The Danielson Mfg.Co., Danielson, Conn. With 6/32- or 7/32-in. O. D., cable has 3/32-in. steel wire-rope core of 920 lb. break test. Danco Nylon is impregnated onto the core. The cable is said to withstand 320,000 flexings before steel core breaks and 410,000 before Nylon severs

Detroit's Thread Plug Gages Made from Chrome-Cobalt Steel

All standard and special thread plug gages made by Detroit Tap & Tool Co., 8432 Butler St., Detroit 11, Mich., are now precision ground from hardened M-11 chrome-cobalt high-speed steel. The steel is said to have high abrasion resistance, thus reducing wear of gages.

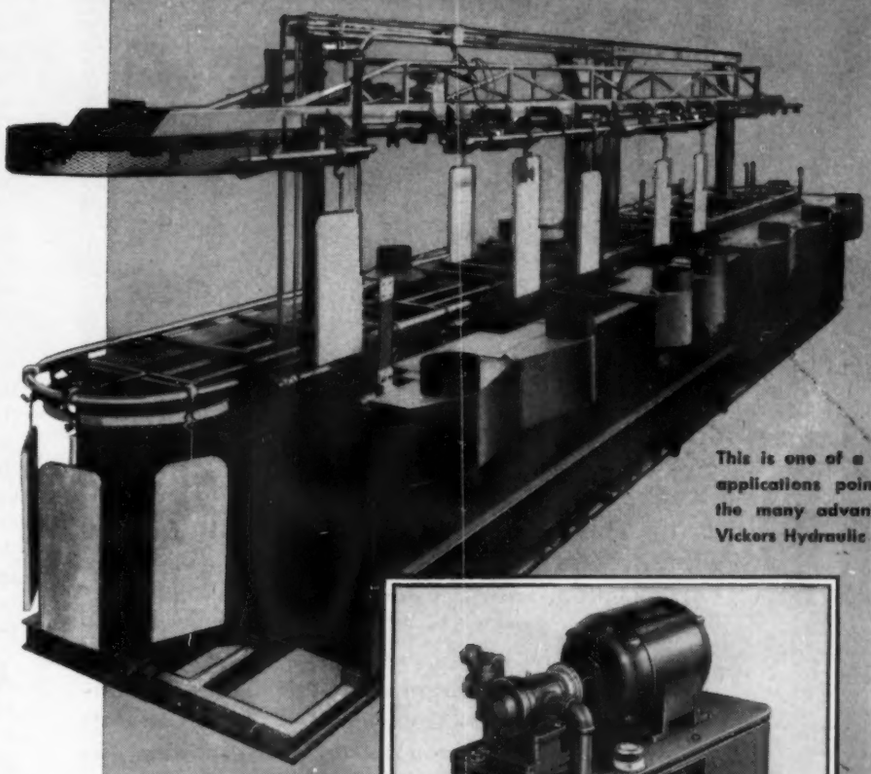
Leeds & Northrup Co. Indicator Logs Thermocouple Temperatures

The Speedomax Indicator for logging a large number of thermocouple temperatures in a short time has been developed by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. The unit can be supplied with switching arrangements to handle more than 100 thermocouples. The operator flips a key switch marked for the desired thermocouple and the instrument's drum scale turns to temperature reading. It is said that speed is limited only by time spent writing down readings.

VICKERS helps achieve HYDRAULIC EQUIPMENT

HIGH PRODUCTION
SPACE ECONOMY
UNIFORM QUALITY

IN *Udylite* AUTOMATIC PLATING MACHINE



This is one of a series of applications pointing out the many advantages of Vickers Hydraulic Controls.

This Udylite machine does a complete plating job automatically . . . taking each part through seven tanks and a drying chamber . . . timing exactly the interval in the various solutions for cleaning, plating and rinsing.

Each part (or rack of parts) is automatically lowered into each of the seven tanks in turn—then lifted out and transferred to the next tank. This might be done with a multiple dip conveyor. But the conveyor slants permissible in lowering and raising in that way require extra tank length.

Udylite made the machine far more compact—saving 18″ to 24″ in the length of each tank—by using Vickers Hydraulic Equipment to raise and lower the entire conveyor assembly at each transfer. By this means, each piece (or rack) is lifted straight out of the tank, moved over the next tank and lowered straight down. This provides better cleaning and more uniform plating—better drainage and less contamination of the solutions.

Above: Elevated position for transfer from one tank to the next.

Vickers Hydraulic Power Unit.

The Vickers Hydraulic Power Unit and Control Valves have many advantages for such applications: (1) proven dependability, (2) accurate control and precise timing, (3) flexibility of control to suit varied production requirements, etc.

The versatile features of Vickers Hydraulic Equipment on this type of application, as on many other industrial installations, have made possible increased production, improved product quality, greater safety, and lessened physical demands upon labor while increasing its productivity. Vickers Application Engineers will gladly discuss your individual control problems.

VICKERS Incorporated
Subsidiary of the Sperry Corporation
1410 OAKMAN BLVD. • DETROIT 32, MICHIGAN
Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI
CLEVELAND • DETROIT • LOS ANGELES • NEWARK • PHILADELPHIA
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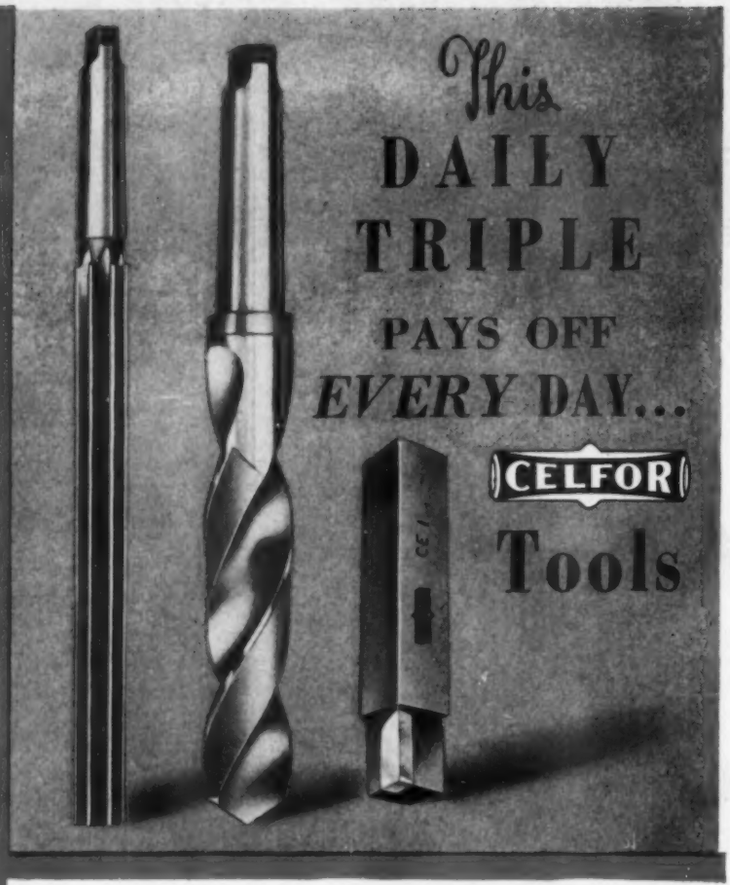
New BULLETIN

Write for Bulletin 46-43 describing Vickers Hydraulic Power Units.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



The outstanding cutting qualities and stamina of Celfor Tools are built into them by Clark's progressive engineering and wealth of "tool savvy," accumulated in nearly half a century of trying to make the best tools. Just how well that goal has been approached is being demonstrated by the tools themselves . . . not on soft set-ups, but on the toughest, meanest jobs, day after day. Cut costs . . . use CELFOR. *The Celfor Line of fine tools is complete for every job:*

- CELFOR HIGH SPEED TWIST DRILLS
- CELFOR REAMERS
- CELFOR CARBIDE CUTTING INSERTS AND CARBIDE TIPPED REAMERS

Write for the new Celfor Catalog with its invaluable 28-page Engineering Data Section. Use your business letterhead.

CELFOR TOOLS
Division of CLARK EQUIPMENT COMPANY
BUCHANAN, MICHIGAN
OTHER PLANTS – BATTLE CREEK, JACKSON, BERRIEN SPRINGS, MICHIGAN

Products of CLARK • TRANSMISSIONS • ELECTRIC STEEL CASTINGS AXLES FOR TRUCKS AND BUSES • AXLE HOUSINGS • BLIND RIVETS INDUSTRIAL TRUCKS AND TRACTORS • HIGH-SPEED DRILLS AND REAMERS METAL SPOKE WHEELS • GEARS AND FORGINGS • RAILWAY TRUCKS

Prices on CLARK *products will not be advanced in excess of increased costs.*

ROUND TABLE Discussion

IS APPRENTICESHIP SLIPPING?

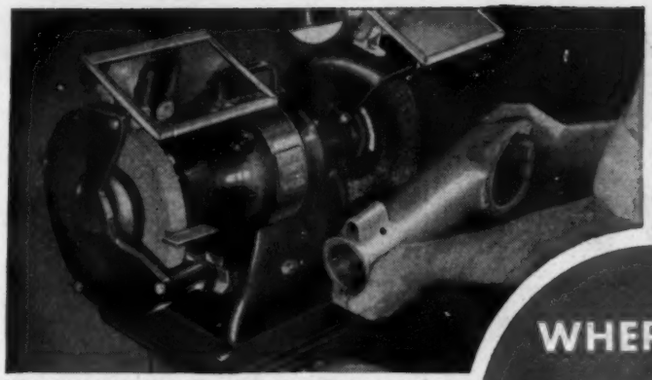
What ails the apprenticeship system in America? In the help wanted section of any city daily paper we can read advertisements like this: "Wanted: Machinist for milling machine work. Experienced only." Nearly every machinist I ever knew has had a hankering to be a milling machine hand at some time or other, but generally has never had the chance to break into milling machine work.

On the other hand, if the ad had read: "Wanted: A machinist for milling machine work. Milling machine experience desirable, but a skilled machinist will be acceptable if he is willing to master the techniques of milling."—applicants for employment would number a good many competent men.

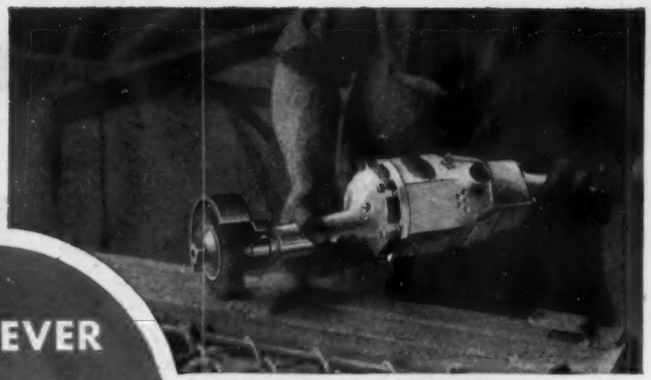
I am citing the milling machine as one instance in many, not only in the metal trades, but in the entire field of skilled labor. Apprenticeships in the machinists' trade are expensive for the employer. There are hundreds of large and small machine shops that offer but poor opportunity for a young man to really learn the trade as it should be learned.

It is true that there are some fine apprenticeship situations, such as Ford, Caterpillar, Navy Yards, and a number of other well-known corporations, but by and large, apprenticeship in America has badly slipped.

A well-planned apprenticeship in a well-ordered commercial shop headed by an intelligent instructor is the best way for a young man to learn the trade—providing the applicants have been properly screened, counseled, tested, and found to be endowed with mechanical sense and ability. Only wealthy corporations that have the future of the trade at heart and really want to make a contribution to the skill of the nation can afford the type of apprenticeship training that today's technology demands. Hundreds of small contract shops in the keen competition of the American free enterprise system have no time or funds to carry on an efficient and uniform apprentice-training program. The result has been a long line of poorly trained mechanics, damaged machine tools, a big scrap pile, and a labor turnover that has made more than

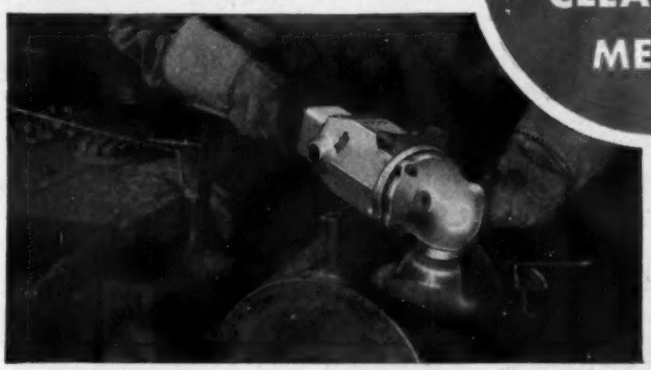


USE THEM WITH BENCH GRINDERS—Whirlwind Wire Wheel Brushes come in six wheel sizes from 4" to 12"; in 1, 2 or 3 sections; and in .014", .0118" and .005" wire. Adaptors fit them to almost any arbor or spindle.

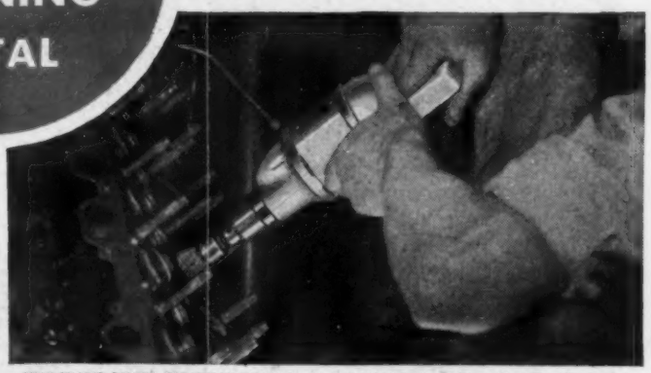


USE THEM WITH PORTABLE GRINDERS—Whirlwind Wire Wheel Brushes come in 4" to 8" wheel sizes; made of .014" wire for rough cleaning, .0118" wire for high-speed buffing, .005" wire for fine burnishing.

WHEREVER YOU'RE CLEANING METAL



USE THEM WITH PORTABLE SANDERS—Whirlwind Wire Cup Brushes come in 4", 5" and 6" sizes, made of .022" wire for tough cleaning jobs. Brush has 5/8", 11-thread bushing; threads on Sander spindle.



USE THEM WITH ELECTRIC DRILLS—Small Whirlwind Cleaning Brushes are ideal for work in close quarters. Available in several shapes, fitting angles, cavities and grooves.

BETTER BUY WHIRLWINDS*

for Better Brushing at Top Speed

It's easy to see why Black & Decker Whirlwind Wire Brushes stand up longer and give you more for your money on high-speed metal working jobs. The simple truth is that an exclusive, patented lock *anchors* each tuft in place, separately, securely, to stay—while their *crimped* wire gives extra life and spring; maintains an even, compact brushing surface.

Whirlwinds speedily remove rust, carbon, scale, old paint, light weld spatter, grease or tar—clean machinery, parts, castings, tanks, structural metal—prepare surfaces for welding—produce a fresh surface that holds paint—do high-speed buffing and fine burnishing or finishing. *Order them today* from your nearby Black & Decker Distributor. Write for our catalog to: The Black & Decker Mfg. Co., 616 Pennsylvania Ave., Towson 4, Md.

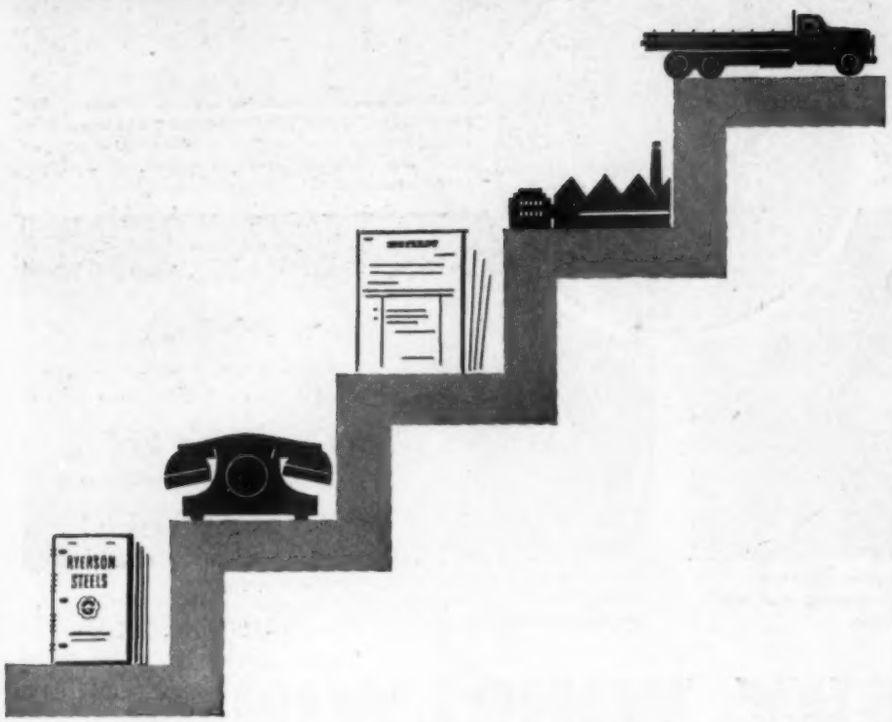
*Trade Mark Reg. U. S. Pat. Off.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS

Stairway to Steel-Service



The need for steel and a call to the nearest Ryerson Plant—that's all it takes to start the smooth-flowing mechanism of Ryerson Steel-Service—a service designed to meet your steel needs as conveniently and as promptly as possible.

At Ryerson each step in the process of filling your order is geared to peak efficiency—carefully executed to eliminate every unnecessary delay between order desk and point of delivery. The most modern steel cutting and handling facilities meet your specifications quickly, with maximum precision.

The Ryerson system of one order—one invoice for a whole group of varied needs saves you time and detail work. And when the steel you need is not immediately available from stock experienced Ryerson engineers and metallurgists gladly assist you in the search for a practical alternate.

Ryerson Steel-Service is the cumulative result of more than a century of experience in the business of steel distribution. Whether your order is measured in pounds or tons, you are always assured of prompt personal attention. That's the reason so many buyers contact Ryerson for all steel-from-stock requirements.

JOSEPH T. RYERSON & SON, Inc., Steel-Service Plants at: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles.

RYERSON STEEL

one frantic executive wonder how we won the war.

Here is a plan that this writer thinks would work if everyone interested would get behind it wholeheartedly. In every industrial center one or more public regional trade schools should be located. It should be a State institution deriving its funds from State and Federal sources. It should rate like any four-year college and have an adequate plant staffed by the best brains in the business, set up to screen, counsel, train and place desirable skilled mechanics. This type of school could put on three- or four-year full-time courses for the young men interested, with dormitories for out-of-the-area residents. Trade extension courses, short refresher courses, special courses for special skills, and many other combinations could be successfully worked out.

What about the financial angle? Enough Federal and State money is wasted today on hundreds of so-called vocational courses in poorly equipped school shops all over the country to go a long way in creating and maintaining these suggested Regional State Trade Schools that would efficiently fill the need for industrial training and be a credit to the "American way."

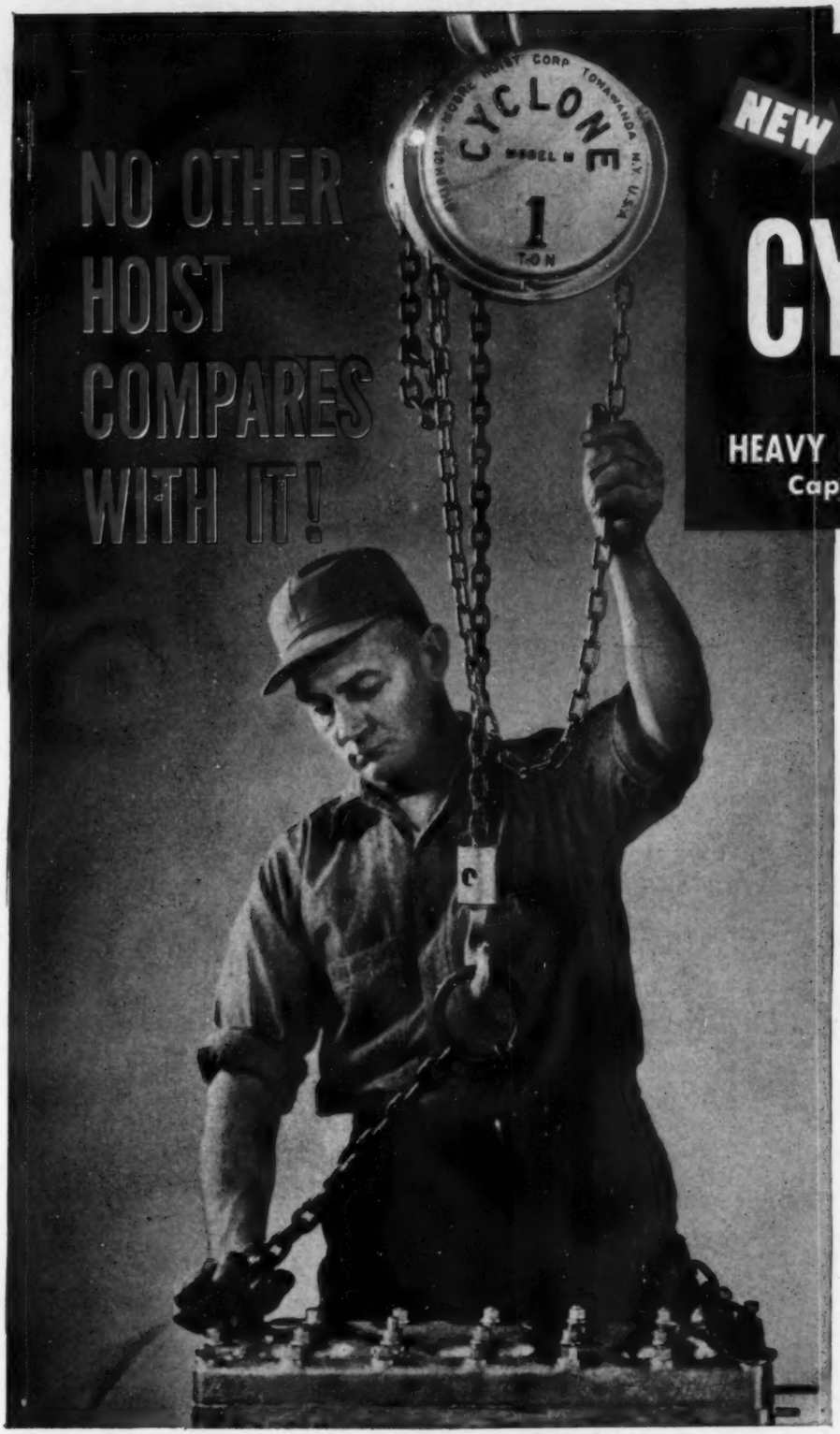
Ralph L. Coleman
Ontario, Calif.

•

Is the spread of mass production, with its one-job standard of skill, tending, if not to destroy, at least to reduce the need for the long period of training which apprenticeship signifies?

At one time all engineering production was of the type needing the services of fully skilled men, whereas today an appreciable proportion is done by specialized methods on single-purpose machines, when all that is required is the ability to do one job. It may even be the willingness to forget all acquired knowledge and to start afresh. What part of the whole this specialized production represents may not be known, but it is suggestd that part of the answer lies here. The other part of the answer may lie in the neglect with which that part of the apprenticeship contract—the teaching of the trade concerned—has been treated by many employers.

In past years, the experience of the apprentice has often been of an unsatisfactory character. For a period of 5 to 7 years, and for a relatively low wage, he will have been afforded the opportunity of spending his wroking time in a shop. For



NO OTHER HOIST COMPARES WITH IT!

NEW **CM**

CYCLONE

Model M

HEAVY DUTY HIGH SPEED HOIST

Capacities from ¼ ton up

→ **96% EFFICIENCY**
conserves worker energy and increases productivity

→ **42% FEWER PARTS**
simplifies maintenance

→ **63% LESS WEIGHT**
yet definitely a heavy duty hoist

→ **Plus SEALED-IN LIFETIME LUBRICATION**
simplifies servicing... prolongs life... maintains efficiency

→ **Plus HERC-ALLOY CHAIN**
America's First and Safest Steel Load Chain

The Cyclone Model M Heavy Duty Hoist is entirely new, completely different. Size and weight have been greatly reduced, and strength and durability greatly increased through the use of today's stronger alloys of steel and Alcoa aluminum. Efficiency and ease of operation have been increased to new high levels through the use of precision ball bearings at all rotating points. The many advantages of this unusual hoist are being demonstrated daily on-the-job by thousands of Cyclone Model M's already in service. *Ask your distributor* to show it to you.

● **New type load brake gives smooth, positive control at all times... exceptionally valuable in spotting or assembly work. Famous CM "Herc-Alloy" double duty alloy steel load chain is standard equipment on all models. The 1-ton model weighs only 35 pounds, has a minimum headroom of only 13⅜".**

CHISHOLM-MOORE

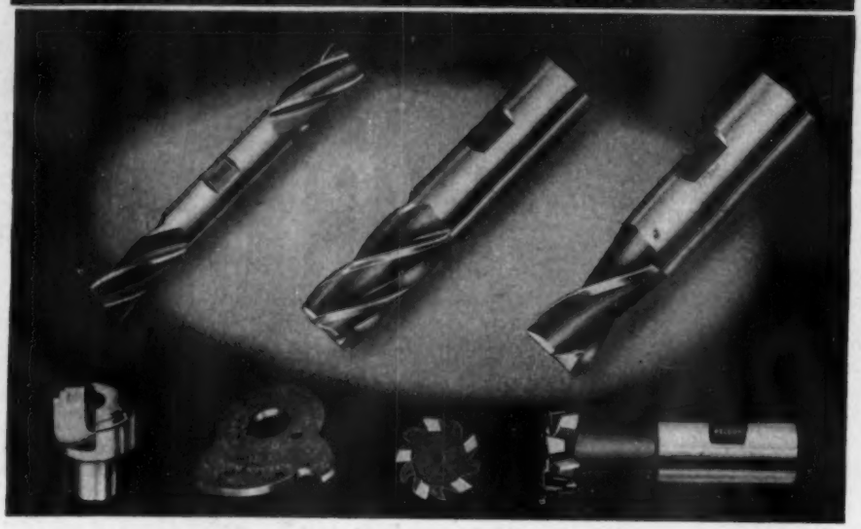
HOIST CORPORATION

(Affiliated with Columbus McKinnon Chain Corporation)

GENERAL OFFICES AND FACTORIES: TONAWANDA, N. Y.

SALES OFFICES: New York • Chicago • Cleveland • San Francisco • Los Angeles

YESTERDAY'S PIONEER . . . TODAY'S LEADER



WELDON *Tools for* WELL DONE *Jobs*

Your cutting jobs can't be any better than your cutting tools. That's why in making WELDON Tools the emphasis is on *quality,* first, last and all the time.

No expense is spared on engineering, material and workmanship to insure the superior performance, strength and dependability of WELDON Tools. Their use is your first step in seeing that your cutting jobs are "well done".

In all important cities throughout the country you'll find Weldon distributors with complete stocks to give you prompt and efficient service.

Write for Catalog 8-B

THE WELDON TOOL CO. *Cleveland 4, Ohio*

3000 WOODHILL ROAD

the first year or so, he was, perhaps, a kind of junior laborer or errand boy; later he will have been given odd jobs on machines, often with insufficient instructions and usually without training. Later he will be given a machine of his own. If at the end of his term of years he had been successful in acquiring sufficient knowledge to enable him to work one or other of the machines concerned, he was then qualified to call himself an improver and begin to learn to master the machine or trade he had drifted to and to complete the training for which he had been apprenticed.

Whatever may be the cause, the training of the fully skilled man seems to be lagging. It may be due to the lower standard of skill required for mass production works, with their high wages for juniors; it may be the result of too low a valuation of the products of apprenticeship, as indicated by the rates of wages paid, but it would seem that apprenticeship, which is not an end in itself, is failing to produce the skilled men which it is, or should be, qualified to do.

J. E. Powell
Lincoln, England

•

Forty-odd years ago, hammer and chisel dexterity was an accomplishment; to excell in screw-cutting and water-scraping on a general-purpose lathe was the height of every intelligent apprentice turner's ambition. Machinists were then only just beginning to emerge and were regarded by the orthodox apprentices —turners and fitters—with disfavor because they were called on to serve a term of only three years rather than five or seven.

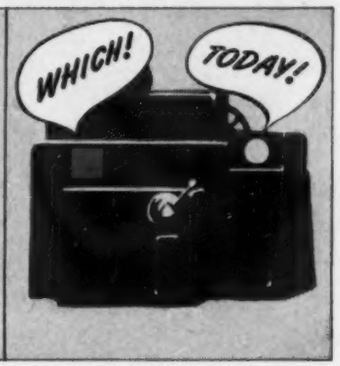
With the introduction of automatic and semi-automatic machines, milling and grinding machines, honing, lapping, profiling and broaching machines, etc., the picture changed. The fitter is now chiefly employed on assembly work, except in the heavy industries or maintenance shops. The accuracy of precision machines has also lessened the use of hammer, chisel and file, especially on mass production and repeat work.

Much the same thing has happened in the matter of general purpose lathes. New types of machines and specialized machines have made severe inroads on what was at one time considered to be purely lathe work, thread milling, grinding, worm hobbing, to cite just a few.

Present-day apprenticeship is well suited to present-day needs, and to apply the system "Ed" grew

Call out the "Color Guard" to cut lubrication failures and costs!

The A B C's of Alemite Coloroute System of Lubrication



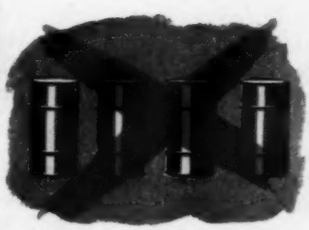
A. Each machine in your plant is analyzed to determine its lubrication requirements. This analysis is made by specialists and does not disturb production schedules.

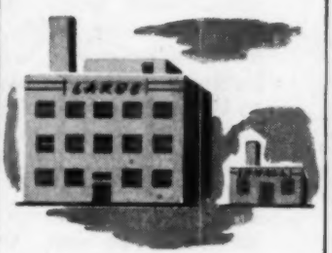
B. Then each lubricant container and piece of lubrication equipment is "color identified." Thus there can be no mistake as to which lubricant or oil goes where.

C. Then color symbols which correspond to the color marking on the lubrication equipment and containers are applied at each fitting, gear case and oil hole.

D. The color of the symbol shouts "which" grease or oil. The shape of the symbol shouts "how often." If lubrication points are out of sight, the symbol shows where it is.

WHAT COLOROUTE DOES





A. It provides a complete "foolproof" plan of lubrication procedure that eliminates "human error." This alone can eliminate many bearing failures and lost production due to faulty lubrication.

B. Coloroute can reduce the number of lubricants required by 30% to 75%. The time required for lubrication is also materially reduced because all points are plainly color marked.

C. After once installed, it works for you automatically. Its economies and benefits are applicable to any plant, large or small. The Coloroute plan is used in every type of industry with amazing results.

D. Send for the new FREE booklet which describes the complete Coloroute Plan. Explains every step and tells how this plan will benefit you. Write today. Ask for the booklet "Caution." Alemite, 1899 Diversey Parkway, Chicago 14, Ill.

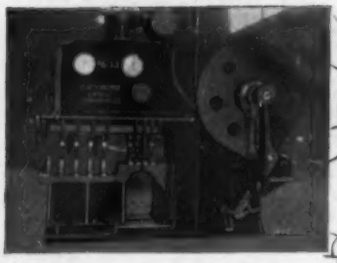
ALEMITE

REG. U.S. PAT. OFF.

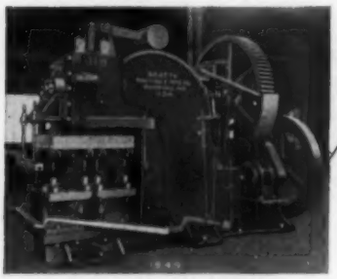
Alemite ALONE Combines all 3 in Lubrication

1. EQUIPMENT 2. PROCEDURES 3. LUBRICANTS

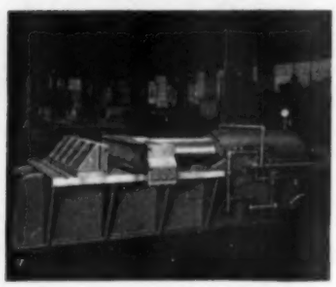
Another Product of STEWART WARNER



BEATTY No. 14 Toggle Punch for structural steel fabrication.

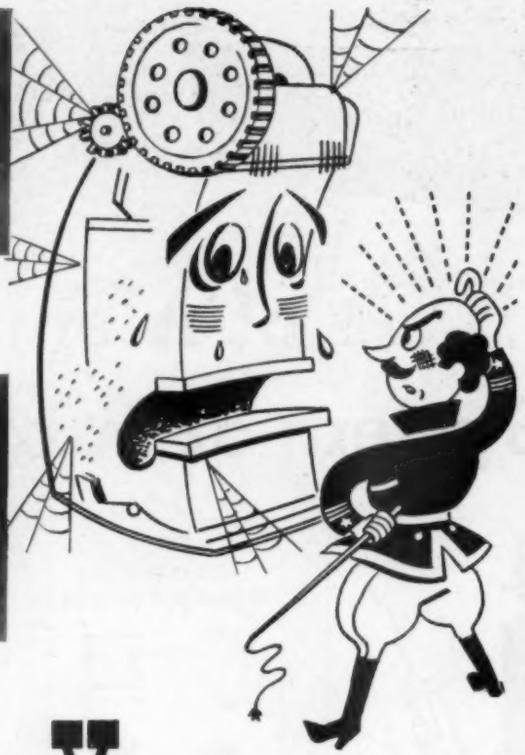


BEATTY No. 11-B Heavy Duty Punch extensively used in railroad industry.



BEATTY Horizontal Hydraulic Bulldozer for heavy forming, flanging, bending.

BEATTY 250-ton Gap Type Press for forming, bending, flanging, pressing.



You can't teach an OLD dog NEW tricks!

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up under to present-day requirements would be folly indeed, since requirements now are more related to specialization and less to versatility in the workman.

It is imperative that the machinists of tomorrow be trained as specialists, if maximum benefits are to be reaped from modern plants.

Modern apprenticeship schemes include frequent lectures, supported by films showing the whole manufacturing process. This is an attempt to arrest a canalizing of the mind, the drawback of specialization.

The modern conception of apprenticeship has undoubted advantages for zealous lads of vision and ambition, but for the equally important group who elect to remain at the tools, it is not so good, since when their apprenticeship is over, opportunities for a variety of work are much less likely than under the scheme which gave "Ed" his industrial training and much of his philosophy of life.

C. D. MacKinnon
Airdrie, Scotland

•

WHO HIRES 'EM

Cooperation between the foreman and the persons trained in the fine points of hiring psychology is greatly desired, but there are some things which tend to create a regrettable breach.

The advantages of having a man hired through the personnel department are that his record is looked into, and if found clean, he is taken in hand, put through the intricate paces of experimental psychology and passed on to the foreman. This has relieved the man in charge of considerable time, which he hasn't too much of. It also saves the shop boss from the task of filling out the many necessary forms.

The disadvantages of the specialized hiring system, unfortunately, are many. The most dangerous is that through the interviewer's ignorance of the details caused by his lack of practical experience, a man may be hired whose claims are grossly exaggerated. Then we have the man who resents having to fill out a questionnaire in which too many questions, seemingly silly, are put to him. He becomes disgusted before he is finished and walks out. The chances are that he is a good man. He may apply for a position with a small outfit that cannot afford the luxury of a personnel department. Very likely he had a few minutes' chat with the busy boss and is told to report to work as soon as possible. The experienced foreman can

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intelligently pass on the applicant's worthiness. I do not think there are many foreman who will let friendship interfere with their conscientious selection.

It could be possible that an occasional reunion between the members of the personnel and the foreman might be effective in promoting closer cooperation.

J. Homewood
Ontario, Calif.

•

To depend entirely upon a personnel office to hire all types of help is a good way to put the supervisor on the spot. Insofar as production is concerned, the personnel department can handle it in fairly good shape because the foreman can state exactly what his requirements are.

However, in hiring a skilled or semi-skilled man, the picture changes. No one can hire a good tool or die maker, or any other highly skilled mechanic, unless he himself is a very good man at that particular trade. Therefore, the personnel office cannot be depended upon to do the hiring of that type of man without the assistance of the foreman.

The only assistance the personnel office can give the foreman is regarding the background of the man. As this information always is obtained second-hand, it really doesn't give the true answer, and in many cases a poor man gets a good reputation and a good man a poor reputation, depending entirely on the circumstances under which the man left his last job. Furthermore, there is no personnel man that can intelligently keep up a conversation with a highly skilled man unless he himself happens to be of the same trade, and to have a personnel man that covers all of the highly skilled trades is asking a lot.

It is my opinion that the production worker can be satisfactorily hired by the personnel office, but for the skilled or semi-skilled worker the foreman should have the final say. In small and medium-sized plants, this can easily be accomplished. In large plants, give the man a gate pass, let him go to see his prospective foreman, let them have a good "shop talk" together.

The time spent by the foreman or his assistant would be less costly than to hire the man and have him come in and perhaps spoil a costly job—at least the chances would be lowered by the above procedure.

Niels C. Thomsen
Denver, Colo.

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NEW BOOKS

PERSONNEL MANUAL FOR EXECUTIVES —*By Ross Young. A unit of the McGraw-Hill Industrial Organization and Management Series. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 18, N. Y. 207 pages, 5¾ x 8¾ in. Price $2.50.*

Emphasizing human relationships, as so many of the new books on supervision do, this manual is unusual in that it answers questions of everyone from those in primary supervision to those in top management. Further, it is not limited to immediate supervisory problems; it goes beyond into suggestions on mental attitude, health, economics, human nature and the like. It further includes suggested additional books for a "two-foot shelf" and a list of movies and slide films suitable for training purposes.

Actually, a wide variety of subjects has here been condensed into a single basic supervisory manual.

•

RADIOGRAPHY IN MODERN INDUSTRY —*Published by Eastman Kodak Company, Rochester 4, N. Y. Available from Kodak X-ray dealers. 112 pages. Price $3.*

It is significant that many erstwhile war contractors did not declare as surplus the X-ray equipment installed in their plants. For the war taught Metalworking that radiography is a certain, low-cost means of determining the soundness of the internal structure of a product and hence the probability of reliable service. And in the field of process development, particularly castings, real savings have been demonstrated by fewer rejects at the foundry and in subsequent machining.

There is, of course, considerable literature on radiographic processes and control. But this book, which succeeds an earlier publication, is significant because of the many specialists who were engaged in its preparation. The material was derived from people in the Kodak Research Laboratories and in the Industrial X-ray Division, and from field representatives who serve as consultants to industries using radiographich techniques. In addition, assistance was derived from manufacturers of X-ray equipment .

The material in the book is written and arranged as a reference for

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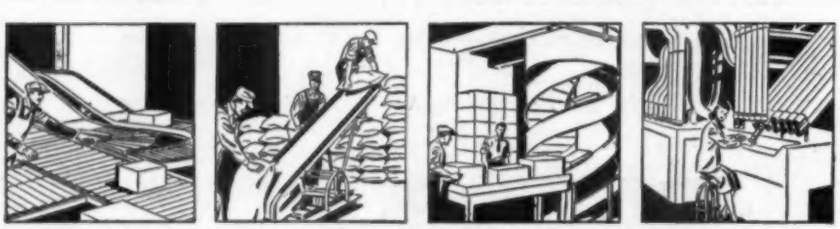

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the professional radiographer and to familiarize executives with radiography's capabilities in modern industry. As a sample of the content refer to "How to Get Good Detail in X-ray Negatives"—*AM*, page 81, Feb. 27, 1947, which discussed such matters as the geometric principles of X-rays and sensitivity and detail visibility in the negative. Other subjects covered include: X-ray generating apparatus, factors governing exposure, use of radiographic screens, special techniques, Kodak films, processing and the processing room layout, causes of poor radiographs, and an extensive bibliography. In short, here is an up-to-date reference book that covers the needs of plant executive in determining what radiography can do for him, and the professional radiographer. The illustrations deserve special mention because they illustrate both principles and techniques.

•

ELEMENTS OF MECHANISM — *By Schwamb, Merrill, and James, (6th edition) revised by Venton L. Doughtie. Published by John Wiley & Sons, Inc., New York, N. Y. 428 pages. Price $4.00.*

First published 40 years ago, the book has been completely revised and brought up to date, while still retaining the original approach to the fundamentals of kinematics and machine design.

In contradistinction to pure machine design, which concerns itself largely with strength and force calculations, this book is restricted entirely to motion and the analysis of motion as applied to machine elements and assemblies. After treating the principles of motion, vectors, velocity and acceleration, the authors take up various basic types of linkages, cams, gears, belts, pulleys, and transmissions.

As a text for a regular course of study, about 45 hr. of classroom and about 90 hr. of outside study are suggested.

•

INDUSTRIAL TRADING AREA MAP OF THE UNITED STATES—*Published by Hagstrom Co., 20 Vesey St., New York 7, N. Y. Prices: paper $12.50, linen back, $20.50, pin-board $23.50, spring roller $31.50.*

Map of the United States printed in black and four colors shows industrial trading areas based on numerous studies and surveys of local trading and buying practices and an evaluation of the national market in

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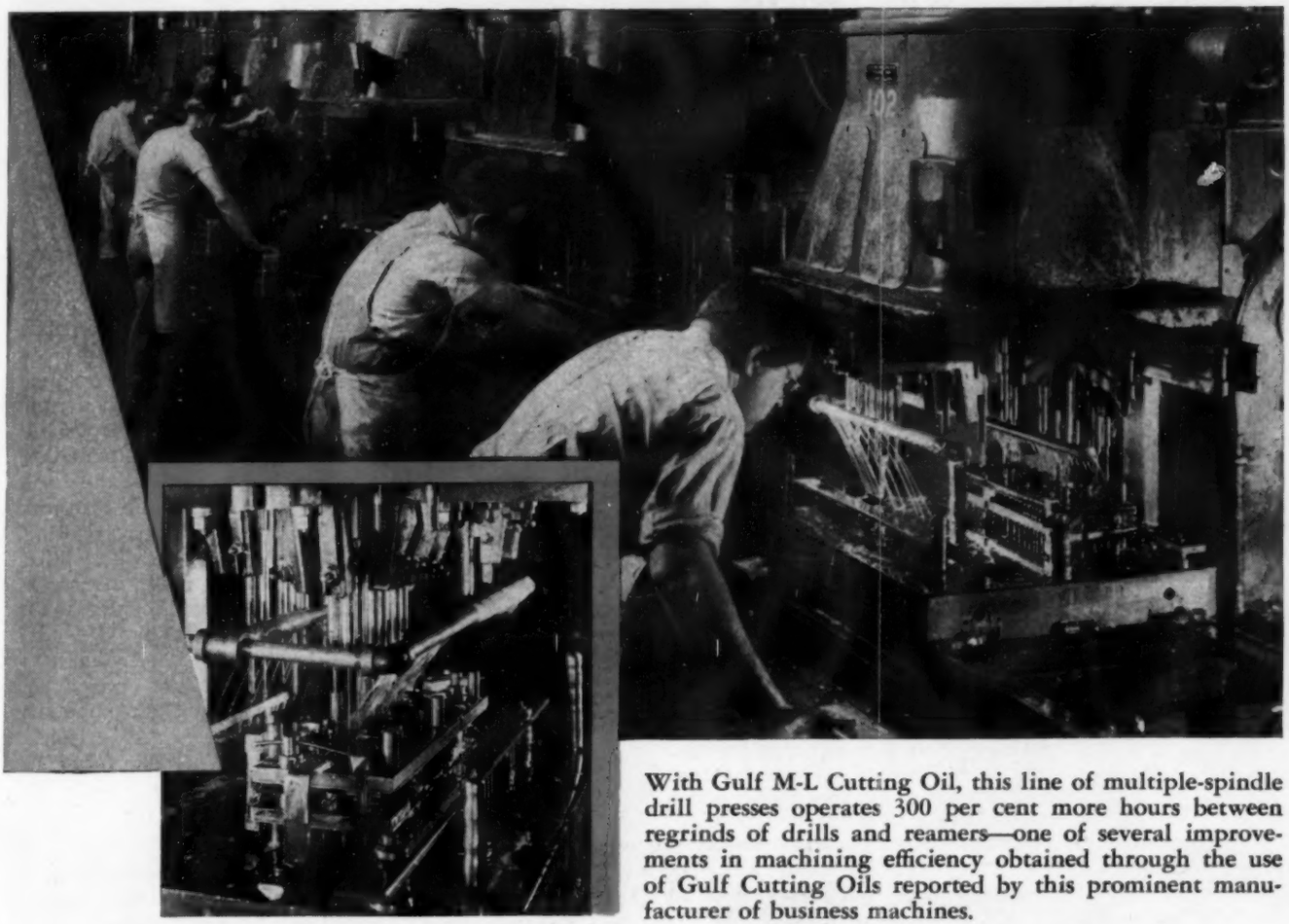

With Gulf M-L Cutting Oil, this line of multiple-spindle drill presses operates 300 per cent more hours between regrinds of drills and reamers—one of several improvements in machining efficiency obtained through the use of Gulf Cutting Oils reported by this prominent manufacturer of business machines.

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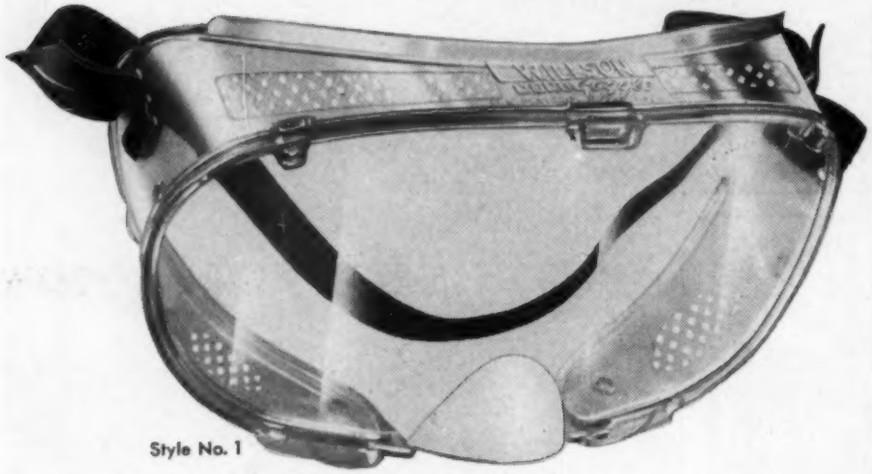

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terms of the smaller buying units.

A supplementary book which accompanies the map contains industrial trading-area statistics and a complete population index. The map is said to be the first general analysis of its kind to answer questions as to the location, size, extent and potential of industrial markets.

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ESSENTIAL BUSINESS MATHEMATICS—*By Llewellyn R. Snyder, San Francisco Junior College and School of Accounting, Golden Gate College. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. 434 pages. Price $2.75.*

This practical text reviews basic arithmetic and covers in detail the practical mathematical problems encountered in business and personal life. The author has written the explanations and devised the exercises so that a knowledge of algebra is not required.

Explanations are more complete and easily understood without the aid of an instructor than is usualy the case with books on mathematics. In addition to the review, the book covers interest and bank discount, trade and cash discount, retailing, ownership and corporate securities, social security and wages, insurance, and taxes. The final chapter deals with averages and graphs.

Throughout the book there is frequent discussion of commonly used short cuts and an appendix discusses a number of additional short cuts that are possible in multiplication.

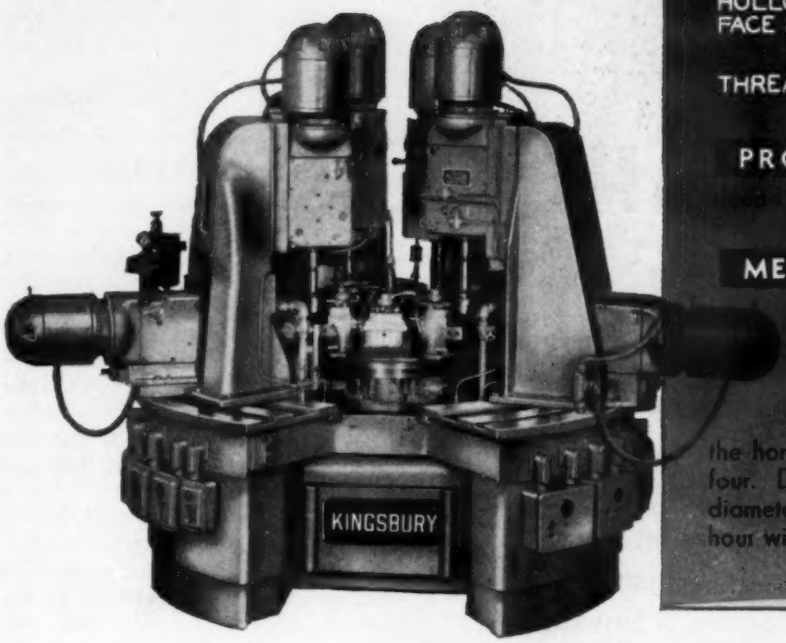
•

READJUSTMENT OR REVOLUTION?—*By Dr. A. H. Edgerton. Published by Whittlesey House, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y. 238 pages. Price $2.50.*

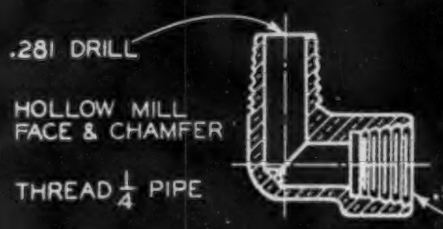
Basic and tested information on how to deal with many situations facing veterans, workers, and students is incorporated in this thought-inducing book. Dr. Edgerton, Professor of Education at the University of Wisconsin and in charge of guidance-training courses, is the author of several other books and has taken a deep interest in the readjustment problems of the postwar era.

Written especially for those directly or indirectly confronted with perplexing problems of readjustment, the book will also prove of aid to employers and others who

1947 MACHINE TOOL SHOW CHICAGO SEPT 17-26



BRASS ELBOW FORGINGS



PROBLEM

METHOD To meet this high production rate, the machine cuts the loading time with air-operated chucks. Drilling the holes in two steps keeps this operation well inside the required time cycle. Mounting vertical units on tunnel columns above the horizontal units reduces the working stations to four. Data: 20 in. index table, 5-stations. Base diameter 80 in. Gross Production: 785 pieces per hour with one operator.

COMBINED OPERATIONS *for* HIGH PRODUCTION

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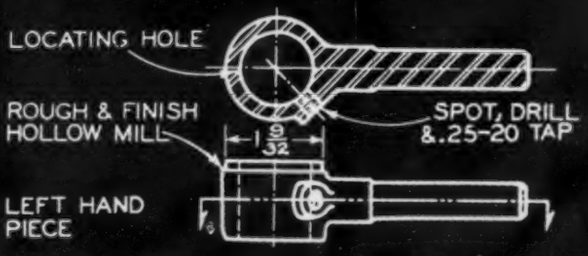
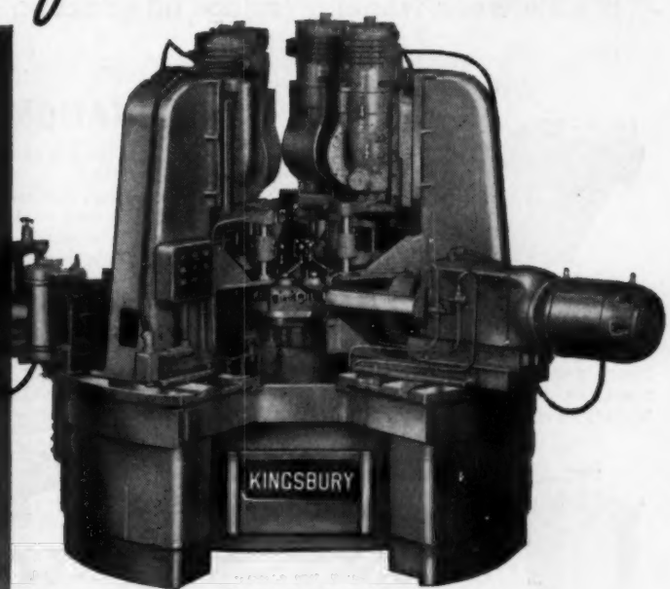


PROBLEM

METHOD By turning out lefts and rights in pairs, the machine has saved money for the customer in first cost and in change-over time. Double fixtures hold a right-hand and a left-hand part, with tapped holes parallel. Horizontal units with two spindle auxiliary heads spot, drill and tap each pair of parts. Separate hollow milling units operate vertically. Ball bearing guide bushings keep the hollow milling concentric with the guide hole. Data: 20 in. index table, 8-stations. Base diameter 80 in. Gross Production: 175 pieces of each hand per hour with one operator.



If you have similar problems, send us a print showing operations and hourly output. We will quote on a completely tooled machine, ready for use. It will have standard units up to 5 hp each and will do accurate work for years at intensive production. Kingsbury Machine Tool Corp., Keene, N. H.

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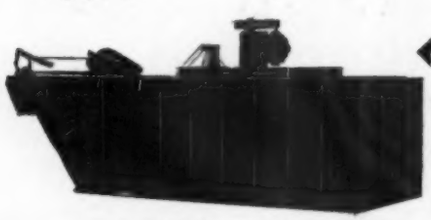

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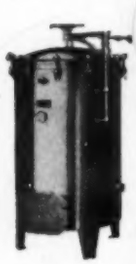

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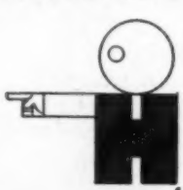

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Direct warnings of the impact of social upheavals wrought by war are qualified by recommendations and suggestions to overcome unfavorable influences.

Industrial Films

The Easiest Way describes a new method for grinding solid carbide milling blades on the small William Sellers surface grinder. This 14-min., 35-mm. sound slidefilm was produced by Pilot Productions, Chicago, and is sponsored and distributed by Carbide Accessories Corp., 211 W. Wacker Dr., Chicago 6, Ill.

Tooling For Better Internal Grinding covers many of the problems encountered in the toolroom and in mass production and shows correct methods, chucking equipment, setups, special and standard fixtures, etc., which help to get the full benefit of internal-grinding equipment. A 16-mm. sound Kodachrome movie, the 1600 ft. of film is provided on a single reel by the Sales Department, Bryant Chucking Grinder Co., Springfield, Vt.

Golden Horizons shows the development of copper-base alloys from the first discovery of copper by primitive man and the alloying of bronze and its growing importance. It also shows the importance of controlled supervision of alloying. This 16-mm. sound, color film was produced and is being distributed by Ampco Metal, Inc., Milwaukee, Wis.

Everyday Miracles tells the story of past, present and possible future use of the carbides. The picture was produced by Wilding Pictures, Chicago, with scenes taken at the Carboloy plant, Detroit. 16-mm. prints of this sound movie, which runs for 25 min., are being distributed by Modern Talking Picture Service, New York, N. Y.

No Help Wanted illustrates the work potentialities of disabled veterans. Available in either 16- or 35-mm. sizes, the film, which runs for 10 min., was produced by Wilding Picture Productions, Inc., and can be obtained from the American Legion, 1608 K St., N.W., Washington 6, D. C.

The Greenlee Automatic Screw Machine is described in a 40-min.,

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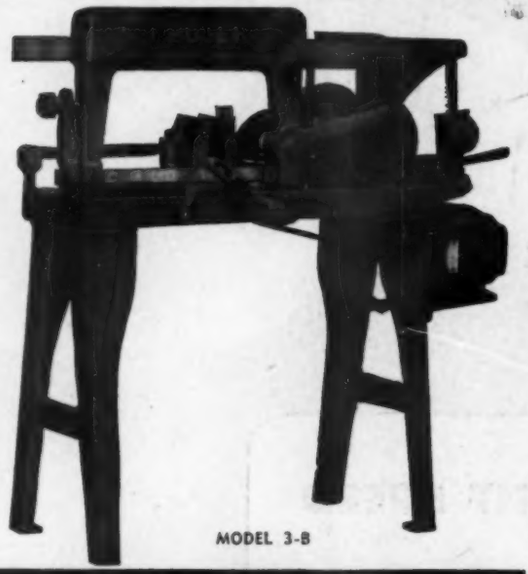
CUT CUTTING COSTS

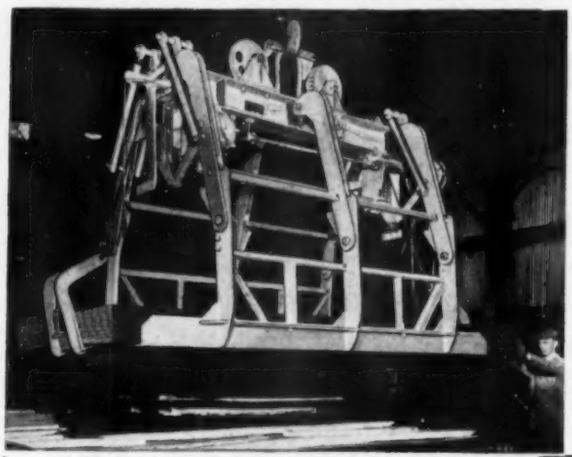
Keller Power Hack Saws are built in several models, priced from $75.00 to $365.00 complete with motors. All models are engineered to handle the maximum quantity of stock, within their capacity, at any desired angle of cut. Choose a model to suit your needs. Write to Dept. A-13 for new catalogue, prices and complete specifications.



MODEL 3-B

Sales Service Machine Tool Co.

2363 UNIVERSITY AVE. ST. PAUL 4, MINNESOTA



You can produce only as much as you can handle

WHEN you use C-F Sheet Lifters to load, carry and unload loose or bundled sheets in and out of storage, you keep no machine or operator idle, waiting for material.

C-F Lifters provide a faster, safe and more economical method of handling sheet stock because they carry more sheets per load, have a tong action that grips loads tightly, preventing stock slippage or sag, yet design features such as wide bearing surfaces give full protection to stock edges. One man end or remote cab control keeps operator away from sides—stock can be loaded or unloaded in close quarters with resulting savings in storage room.

Jaw controlling mechanism provides infinite adjustments from minimum to maximum widths. Control is fast, positive. C-F Lifters have standard and optional equipment that will exactly meet any materials handling requirement you may have. Lifters are available in capacities from 2 to 60 tons or larger, in standard or semi-special designs. Write for new illustrated Bulletin—just off the press.

CULLEN-FRIESTEDT CO.

1313 S. KILBOURN AVENUE CHICAGO 23, ILL.

16-mm. sound movie showing the construction and operating features of the machine, with special attention given to the principles of operation and setup. The film may be obtained from Greenlee Bros. & Co., Rockford, Ill.

Dateline Tomorrow discusses mechanical, chemical, electrochemical, electroplated and organic finishes that can be applied to aluminum and includes demonstrations of part of the manufacturing operations. Made by Jam Handy Organization, 16-mm. and 35-mm. prints may be obtained from the Aluminum Co. of America, Pittsburgh, Pa.

Design For Arc Welded Structures has been produced to aid people in the structural field visualize the improvements in design and construction which are made possible by arc welding. Produced by Herb Lamb Productions, this 15-min. film is available in 16-mm. sound color prints from The Lincoln Electric Co., 12818 Coit Rd., Cleveland 1, Ohio.

Report on Jet Propulsion depicts the story of the P-59 *Airacomet*, the first jet-propelled plane in the U. S. and traces the jet principle from the first century to modern times. Drawings showing how the jet engine gets its power are shown, as well as scenes showing the construction and flight testing of the P-59. This 25-min. sound color film is being distributed by the producer, Bell Aircraft Corp., Motion Picture Div., Buffalo 5, N. Y.

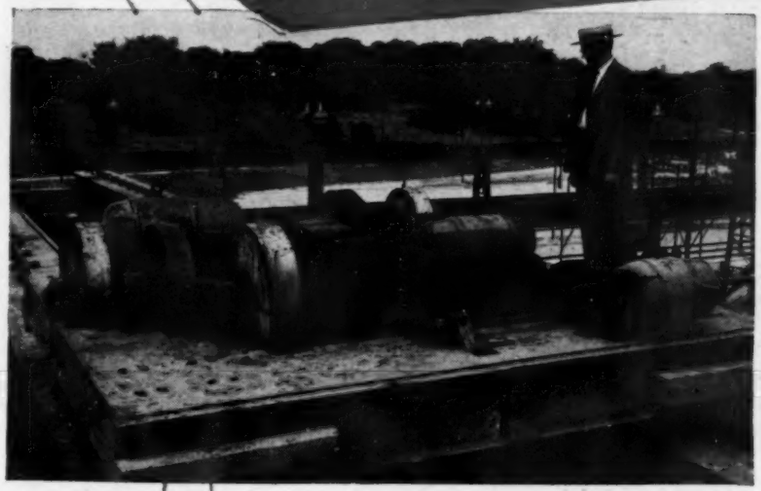
The Railroad Signal is the third film in the New York Central's "Running the Railroad" series showing the railroad's complicated automatic signalling equipment in operation, various signals used and their meaning to the men who run the trains. Information about this 16-mm. black and white film with a running time of 17 min., may be obtained from the Motion Picture Bureau, New York Central System, 466 Lexington Ave., New York 17, N. Y.

To Live In Darkness tells the stories of three men who didn't wear their safety goggles for a few minutes and became blinded for life as a result. The 13-min. film is intended primarily for machinists, welders and others who wear goggles on the job, but it is also an argument for safety in industry. Twentieth Century Fox produced this 16-mm. film for the Navy and it is being distributed by Castle Films, 30 Rockefeller Plaza, New York, N. Y.

Melting of Huron Die Steel reveals what the human eye has never before been able to see—the true color of molten steel and slag. By use of a telephoto lens, the camera cre-

CENTURY Slip Ring Motors

Provide Maximum Flexibility — For Speed Regulation . . . Torque Control . . . Reversing Direction of Rotation



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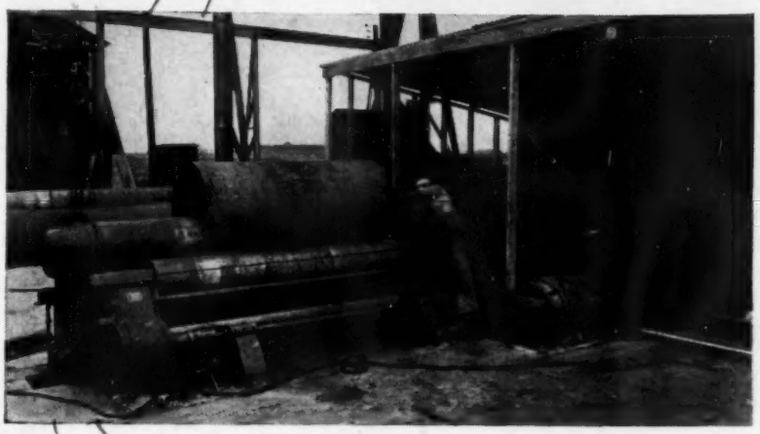


2

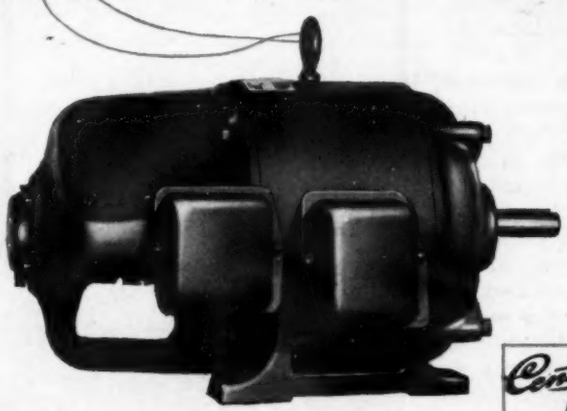
The two installations shown here demonstrate how Century Slip Ring Motors provide the flexibility needed to meet varying load conditions.

Illustration No. 1 shows 4 Century Totally Enclosed Slip Ring Motors on an outdoor crane. One motor powers the crane travel, one the carriage cross travel, one on small load hook and one on large load hook.

Century Slip Ring Motors provide variable speeds for the travel and hoist motions of the crane. Reversing direction of rotation permits crane travel in either direction.

In Illustration No. 2 the bending roll is driven by 2 Century Slip Ring Motors—75 horsepower and 30 horsepower. One operates the two power rolls and the other raises and lowers the third roll which regulates the amount of curvature of the steel plate.

Because plate thickness up to $1\frac{7}{8}$" are handled, this machine requires a great variety of speeds and torque. Low starting current is another requirement which is easily met by Century Slip Ring Motors.



When your requirements demand that electric motors have flexibility for speed variation, torque control, reversing of direction of rotation and high starting torque with low starting current, specify Century Slip Ring Motors.

Century builds a complete line of fractional and integral horsepower electric motors in the popular sizes to meet the requirements of industrial, commercial and appliance needs.

Specify Century for all your electric power needs.

Century C MOTORS

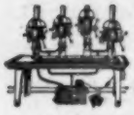
CENTURY ELECTRIC COMPANY
1806 Pine St., St. Louis 3, Mo.
Offices and Stock Points in Principal Cities

538

GRAY-MILLS

PORTABLE
PUMP UNITS

Use these compact self-contained units as



...Coolant Systems for all types of Machine Tools

...Stand-by Pump Units in case your built-in pumps fail

... automatic Die or Stock Lubricators on punch presses
(Ideal for coil stock)

... for hundreds of special applications—circulating or applying liquids of many kinds

GEAR and CENTRIFUGAL PUMPS
Volume to 43 GPM—Pressures to 50 PSI
5- 12- 38-GALLON CONTAINERS

See Your Industrial Distributor or write to Gray-Mills for catalog

GRAY-MILLS CORPORATION
1953 Ridge Ave. Evanston, Illinois

ates the impression of being inside the furnace during the melting process. This dramatic 15-min. film is available from the Public Relations Dept., Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh, Pa.

Corrosion explains the mechanism of corrosive attack and the development of stainless steels. Available from the Public Relations Dept., Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh, Pa.

A Supervisory Development Program has been developed by the Vocafilm Corp., New York, N. Y., in the form of a visual-training discussion course. Designed for any supervisory group—from foremen to works managers—to focus on problems involved in increasing and maintaining a satisfactory standard of production as well as how to apply sound principles of management and human relations to current problems. Topics of the eight films making up this series of sound-slide films are: *Freedom of Opportunity, Effective Management, Individual Output, When You've Got A Problem, Getting Ideas Across, The Will To Produce, Understanding People,* and *Individual Adjustment.*

An American Miracle, a two-reel sound film released by General Motors, visualizes the intensive planning, engineering and machinery necessary to achieve a balanced production line on a relatively small and easy to produce item as exemplified by a 3-in. projectile. It may be borrowed from Association Films, YMCA Motion Picture Bureau, 347 Madison Ave., New York 17, N. Y.

Light Is What You Make It analyzes the way artificial light can help or hinder sight and describes the most common lighting faults. A 16 mm. technicolor and sound film produced by Walt Disney, the prints may be obtained from local electric utility companies.

Partners In Production is directed toward the human element in industrial accidents and is based on the theme that no plant safety program can succeed without the full and constant cooperation of every employee. Specific safety rules are stressed. This sound film in full color is available through agents of the Aetna Life Affiliated Companies.

The Magic Wand depicts the modern methods of joining metal by electric arc welding. Produced by Science Films, Inc., under the supervision of The Lincoln Electric Co., the film is being offered free to theatres via Modern Talking Picture Service's 31 exchanges. It comes in a 10-min. as well as a 23-min. version.

Threaded Products For Western

"Here is another example of SUPERKOOL superiority for precision grinding"

...excerpts from D. A. Stuart Oil Co. Performance Report on SUPERKOOL 31K

PROBLEM: Precision grinding finish of 4 to 6 micro inches required on compressor valve units, using a 500 grit wheel on Norton Hyprolap machines. Previous mixture of 1 part kerosene and 2 parts red engine oil unsatisfactory.

SOLUTION: Use of a 1 to 1 blend of SUPERKOOL 31K and kerosene.

RESULTS: Operator reported less mist from the machine...Production increased to 200 pieces...Finish improved 2 to 4 micro inches...subsequent tests proved completely satisfactory results by using SUPERKOOL 31K straight on micromatics, and the above dilution on the Hyprolap machines... Foreman and lubrication engineer well pleased...orders for SUPERKOOL 31K to be placed as required.

O. M. Gibbon
D. A. Stuart Oil Co., Representative

STUART *service goes with every barrel*
WRITE FOR DETAILS

D. A. Stuart Oil Co.
2729 SOUTH TROY STREET, CHICAGO 23, ILL.

FOR REGULAR DUTY
Ground (Bur) and Hand Cut (File) Types—with ¼" shanks; 16 standard shapes; 3 cuts (Coarse, Medium, Fine); ⅛" to 1⅛" stock diameters.
Ground (Bur) and Hand Cut (File) Types—with ⅛" shanks; 9 standard shapes; 1 cut only; ⅛" to ⅜" stock diameters.
FOR PRECISION WORK

JUST as Nicholson has long made hand files for every purpose, Nicholson now offers industry rotary files in a wide variety of practical shapes and sizes: both hand cut and bur ground; both with standard ¼" shanks, and with ⅛" shanks for finer work.

Nicholson Rotaries are manufactured under a thorough study of all the conditions and requirements of operation through flexible shaft, drill press, or portable electric or pneumatic power tool. Beginning with carefully selected high-speed tool steel, they are perfectly rounded, true-centered, accurately cut or ground, expertly hardened—made with high shock and fatigue resistance, and for *long service*. You'll find them fully worthy of association with the long-standing Nicholson tradition of *Twelve perfect files in every dozen.*

(Many of the Nicholson ¼" shank bur shapes are also made of cemented carbide—*with up to a hundred times the wearing quality of high-speed tool steel.)*

YOUR INDUSTRIAL DISTRIBUTOR CAN FILL YOUR NEEDS AND RENDER HELPFUL ASSISTANCE ON SELECTIONS.

NICHOLSON FILE CO. • 97 ACORN STREET, PROVIDENCE 1, RHODE ISLAND
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NICHOLSON ROTARY FILES

HAND CUT AND GROUND—FOR EVERY PURPOSE

NICHOLSON U.S.A.

HALLOWELL

"SOCKET SCREW" KIT
with interchangeable tools

For men who like to have a handy, useful set of tools, yet dislike bulk and "tool hunting", Hallowell "Socket Screw" Kits are the answer. Their tread-grip, hollow red plastic handles contain interchangeable, high-grade steel bits for most all purposes where Phillips, Hex and Slotted Head Screws are used. Each has a swivel bit-chuck that locks securely in any one of five positions.

Hallowell "Socket Screw" Kits are made in 2 sizes #25, medium; and #50, large. Other Hallowell Kits include: "Socket Wrench"; "Auto"; and "Home".

Obtainable at Industrial Distributors and Hardware Dealers throughout the country. If there is no Supplier in your locality, or he is sold out, send his name to us, along with yours, and you will be taken care of promptly.

An ideal gift or prize.

Kits: Patents Pending

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FAST FEED PRESSES
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Industry shows the manufacture of threaded bolts and cap screws in various sizes from raw steel to finished product. Scenes include cold and hot heading processes, laboratory testing and tool and die making. Inquiries about this 33-min. sound color film go to the Cooper Screw Manufacturing Co., Los Angeles.

Payloads Pay Off shows the latest types of material handling equipment and the most advanced methods of using it. This three reel, 26 min. picture is presented by the Institute of Visual Training and produced by the William J. Ganz Co., New York, N. Y., under a grant from Automatic Transportation Co., with the cooperation of General Electric Co. Prints of the film are available in both 16-mm. and 35-mm. sizes from the Institute at 40 East 49 St., New York, or through any representative of the Automatic Transportation Co.

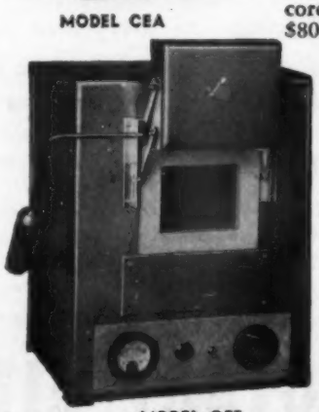
Surface Broaching gives a graphic demonstration of how effectively surface broaching is accelerating the production of many everyday products and its important role in modern machining. The 16-mm. color film, running 17-18 min., is available for exhibition and may be accompanied by an address by the chief engineer of LaPointe Machine Tool Co. Dept. W-33, Hudson, Mass.

TEMCO

ELECTRIC FURNACES

MODEL CEA

Model CEA is designed to give outstanding performance at low initial and operating costs. Has special high temperature heating element embedded in four sides of muffle lining for protection and uniform heating. Built with TEMCO stepless control which permits operator to select and hold any temperature from 500° to 2000° F. Maintains even temperature regardless of normal changes in line voltage. Heating chamber 4¾"x4¼"x6". Max. input 1.5 kwh. Insulated cast-aluminum body. Supplied with attachment cord ready to plug in and operate. For 115 V. AC $80.00; 230 V. AC $85.00. *Also available for DC.*



MODEL OFE

Model OFE is built for continuous use up to 1600° F, intermittent to 1900° F. Synchronous motor driven input controller permits selection and holding of any temperature from 250° F to maximum. Highest quality nickel-chromium alloy heating element covers four sides of chamber. Steel frame with 4½" insulation. Counterbalanced door opens upward. Muffle chamber 6"x5"x10". Maximum power consumption 2.2 kwh. For 115 or 230 V. AC $194.00.

Models CEA and OFE are equipped with an indicating pyrometer calibrated in both F. and C. scales. They are economical to operate as nearly all the power is consumed within the heating chamber. Ideal for general laboratory uses, heat treating and small unit production.

See your supply house or write for descriptive bulletins

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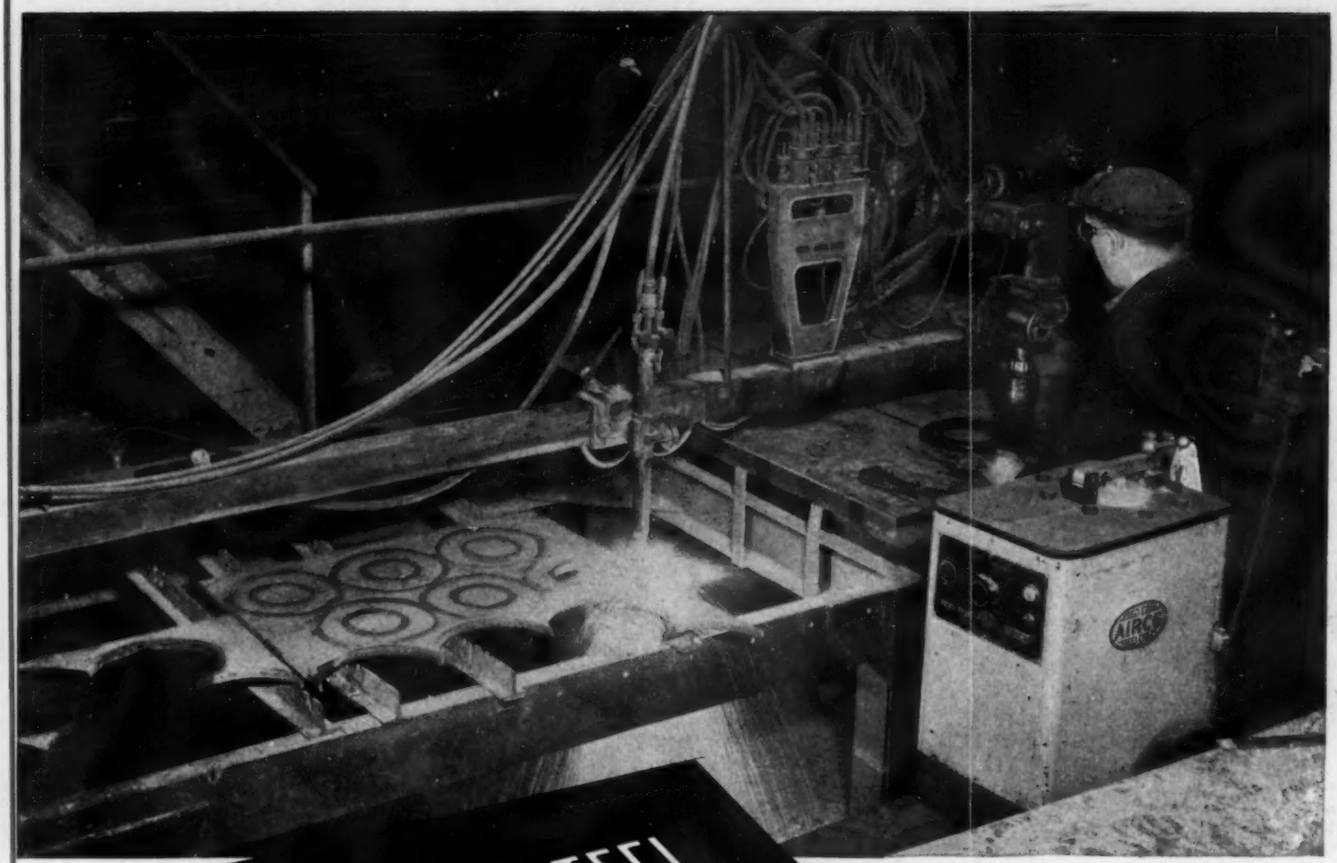

cut ⅓ cheaper... and 6 times faster

That is the enthusiastic report on Airco's new Flux-Injection Method of cutting stainless steel at American Fabricators, Inc., of Louisville, Kentucky.

They continued: "We are well satisfied with this Airco process. Cutting #347 stainless, ⅝" thick, we operate at least ⅓ cheaper and 6 times faster than if it were cut mechanically . . . and the operation, at all times, has been very satisfactory."

So say satisfied users from every part of the country. They know the important savings that can be obtained by this new stainless steel cutting technique over the slow, laborious "melting-away" and mechanical processes.

Designed for use with standard Airco oxyacetylene equipment, this new Airco stainless steel cutting method keynotes simplicity, safety and production economy. It brings operating conditions for stainless steel cutting to mild steel ranges, with comparable speeds.

An explanatory article — "Flux-Injection Method Brings Economies of Oxyacetylene Flame Cutting to Stainless Steels" — is available. For your free copy, write: Dept. A.M.-6142, Air Reduction, 60 East 42nd St., New York 17, N. Y. In Texas: Magnolia Airco Gas Products Co., Houston 1, Texas. Represented internationally by Airco Export Corporation.

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Now...prompt deliveries on U·S·S Carilloy Steels

...the alloy steels with a Guaranteed Minimum Hardenability

Symbol of Service

FOR STEEL USERS

UNITED STATES STEEL SUPPLY COMPANY — USS STEELS — SERVICE

YOUR alloy steel requirements are best served by our stocks of constructional AISI alloy steels readily available from our warehouses. U·S·S Carilloy Steels are manufactured to a ***Guaranteed Minimum Hardenability.*** Charts are furnished with each shipment to you as your guide and assurance of this ***Guaranteed Minimum Hardenability.***

Moreover, when you place an order for U·S·S Carilloy Steel, our metallurgical service goes a step further: *We send you data with each individual shipment showing complete and specific information about the steel you receive.* This specific data on its composition, potential physical properties, and fabrication will guide you in obtaining maximum performance from the steel furnished on your order. Take advantage of all this information in supplying your alloy steel requirements. Use U·S·S Carilloy Steels from our large stocks.

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NEWARK (1), N. J.	Foot of Bessemer St., P. O. Box 479	Bigelow 3-5920 REctor 2-6560 BErgen 3-1614
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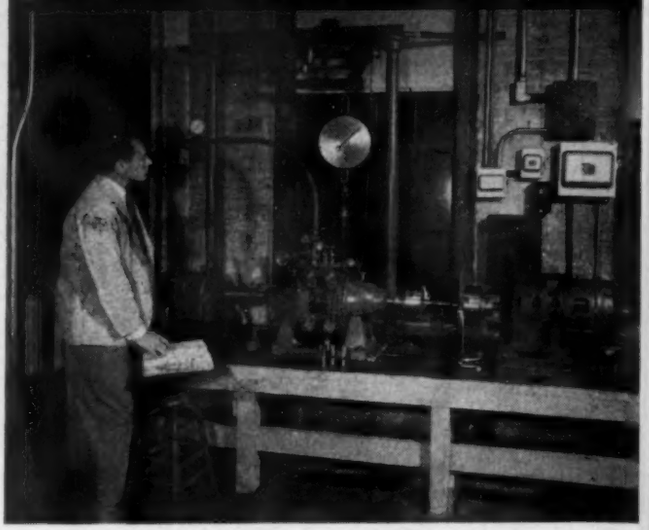
UNITED STATES STEEL

JUST A FEW CENTS MORE



But What a Difference IN·WHAT·YOU·GET!!

Yes, a Curtis Universal Joint may cost a few cents more than other joints, but the smart designer or engineer **knows** the difference in the service delivered by Curtis Joints.

Machined from special alloy steel bars, not forged, the hubs of our joints are the same diameter throughout — giving uniform strength at all points. Compact, with greater strength, Curtis industrial type joints of a smaller size can many times replace larger, more cumbersome joints. A glance at our Engineering Data Chart showing breaking loads by joint sizes will convince any engineer.

In addition, Curtis forks, centerblocks and pins are all heat treated for maximum toughness. Pin holes are broached and honed for perfect alignment — pins are centerless ground to close tolerance to reduce radial play — center blocks are precision ground for long wear with special oil grooves to permit adequate lubrication. Patented "Telltale" lock ring insures positive lockup of entire assembly and visible end shows ring is in proper locking position.

All this **means** smoother, longer life with lower maintenance cost — for just a few cents more per joint.

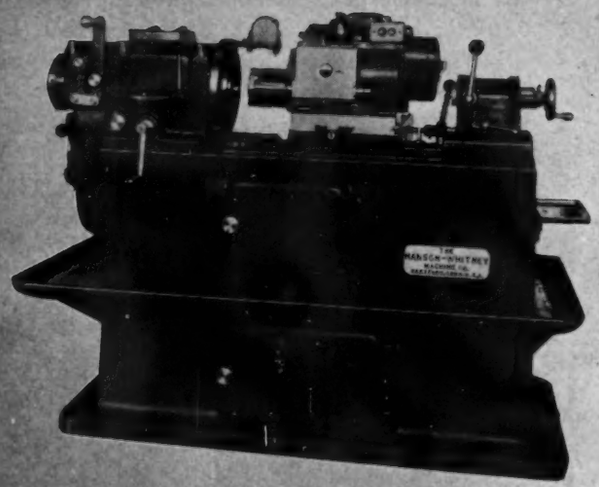
Specify **Curtis Universal Joints** always — Write for Engineering Data and useful Templates.

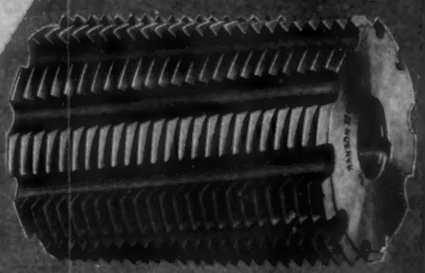
DEPT. B-3

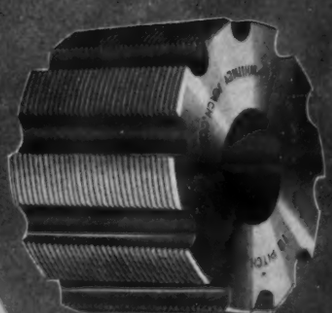
CURTIS UNIVERSAL JOINT CO. INC. SPRINGFIELD, MASS.

A COMBINATION THAT'S HARD TO BEAT

. . . Hanson-Whitney semi-automatic thread milling machines and ground multiple thread milling cutters







This combination assures you speed . . . accuracy . . . no spoilage . . . economy and lower costs. Except for loading and unloading the H-W Thread Miller is entirely automatic and produces external or internal, right or left hand, straight or tapered threads in one revolution of the work. The cutters are finished all over after hardening, the spacing, form and relief being held to very close limits. They can be relied upon for accuracy and durability. Inquiries pertaining to thread milling problems respectfully solicited.

Hanson Whitney

MACHINE COMPANY

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Think of haskins *FIRST... because they LAST!*

HS-4, ½ h.p. multi-speed, countershaft unit. 1500 to 7800 R. P. M., mounted on caster base, 360° swivel. One of many models.

Diemakers, moldmakers, fabricators —all become better, speedier craftsmen when they use Haskins Flexible Shaft Machines for grinding, buffing, polishing, sanding, rotary filing, wire brushing.

Yes, Haskins portable tools are *first* in the shop—and *first* in the front office where cost records prove their negligible maintenance cost, their year-after-year usefulness under tough, high-production conditions.

If flexible shaft machines could help solve *your* production, think of Haskins, *first!* Send for details. R. G. Haskins Company, 2641 W. Harrison Street, Chicago 12, Illinois.

HASKINS

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FLEXIBLE SHAFT EQUIPMENT

+ INCREASED PRODUCTION
— REDUCED SETUP TIME
- DAYTON ROGERS DIE CUSHIONS

No matter how you figure it Dayton Rogers Die Cushions will assure better results and lower production costs on your punch press operations because:

1. They are readily adapted to either short run quantity requirements or for large quantity production.
2. They automatically convert a press from single action to double action for deep drawing work.
3. Correct pressure pad control on forming dies obtained quickly by simply adjusting the pressure regulator.
4. They afford positive stripping action on all compound, blanking and piercing dies.

Write for illustrated, engineering catalog #100-1

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Manufacturing Company
MINNEAPOLIS 7, MINN.

The CECO DROP completes a forging with fewer blows than the conventional gravity drop hammer

CHAMBERSBURG
Builders of IMPACT Machinery
1897 • Fiftieth Anniversary • 1947

CHAMBERSBURG ENGINEERING CO. • CHAMBERSBURG, PA.

FREE LITERATURE

New Catalogs, Booklets, Bulletins

(Not good after August 1, 1947)

MACHINES AND ATTACHMENTS

1 MACHINE TOOLS—Rockford Machine Tool Co., Rockford, Ill. 32-page catalog describes Hy-Draulic planers, shapers, slotters, shaper-planers and special installations. Includes dimensions and data.

2 PLANER—The G. A. Gary Co., Cincinnati 7, Ohio. 18-page bulletin 55 describes and illustrates Gray Openside Planer Cub made in nominal sizes of 24, 30 and 36 in. Units have non-metallic table ways, employ Space Saver drive.

3 CHUCKING MACHINE — Hardinge Brothers, Inc., Elmira, N.Y. 26-page bulletin describes Multi-operation chucking machine available in any one of four speed ranges. Spindle capacity is 6-in., and there is an 8-position cross-feeding turret.

4 GRINDING ATTACHMENT—Gale Forssen Co., Springfield 9, Mass. 4-page bulletin on rotary grinding attachment made by Star Gauge Co. Unit is for surface grinders, takes work approximately 3 in. long, depending on dia.

5 INTERNAL GRINDER — Bryant Chucking Grinder Co., Springfield, Vt., 4-page bulletin describes series 109 automatic internal grinder for small and medium bores. Total chuck swing is 9-in., max. traverse stroke is 6 in. and max. grinding stroke is 4 in.

6 MILLING MACHINES—The Van Norman Co., Springfield, Mass. Bulletin contains information and specification data of 22L and 22M ram-type milling machines. Describes adjustable cutter head, movable ram and other features.

7 DRILLING MACHINES—Davis and Thompson Co., Milwaukee 14, Wis. 4-page bulletin 101 describes vertical multiple-spindle continuous drilling machines which incorporate Roto-Matic principle of constant rotation and cutter operation.

8 ELECTRICAL TOOLS—The Bradford Machine Tool Co., Cincinnati 4, Ohio. 32-page catalog 50 on Metalmaster electrical tools including ball-bearing drills, grinders, buffing and polishing machines, and attachments and accessories.

9 HOLE PUNCHING—Wales-Strippit Corp., North Tonawanda, N. Y. 16-page catalog describes type "CD" hole-punching units used in press brakes and stamping presses. Price list included.

10 BENDING—Tangent Bender Div., Struthers-Wells Corp., Titusville, Pa. First issue of monthly bulletin, "Tangent Bender News." Each issue will contain facts and photos describing a single application where a Struthers-Wells tangent bender has been used.

11 CALCULATOR — Republic Steel Corp., Cleveland 1, Ohio. "Spindle Speed Selector" permits selection of cutting speeds and feeds for all common machining operations on eight types of Republic Enduro stainless steel. It also converts surface cutting speeds to spindle speeds for stock from 0.1- to 8-in. dia.

12 FILING MACHINE — Connecticut Tool & Engineering Co., Bridgeport, Conn. 4-page bulletin describes Universal filing machine with max. 5-in. stroke, 10¼-in. throat and 75 to 300 strokes per min.

13 MACHINE TOOLS—Atlas Press Co., Kalamazoo 13D, Mich. 64-page catalog covers lathes, shapers, milling machines, drillpresses and coolant systems. Describes attachments and accessories and includes price list.

14 PNEUMATIC TOOLS — Skilsaw, Inc., Chicago 30, Ill. Bulletin describes pneumatic Skil Tools. Line includes Skil Drills, Skil Drivers, Skil Hammers, Skil Grinders and Skil Runners.

15 DRILLPRESS—The Electro-Mechano Co., Milwaukee 2, Wis. 4-page bulletin on high-speed precision drillpresses with speeds from 1000 to 10,000 or 2500 to 15,000 rpm. Speeds are changed with fingertip control, and motor and spindle are on same shaft.

16 AUTOMATIC UNITS — Langelier Mfg. Co., Inc., Providence, R. I. 4-page bulletin describes automatic units used in special machines for drilling, milling or other operations. Also describes lead-screw tapping units. Two 2-page bulletins on hammering machines and No. 41 ball-bearing drill also available.

17 HACKSAWS—Sales Service Machine Tool Co., Inc., St. Paul 4, Minn. 4-page bulletin 101 describes Keller power hacksaws made in six models. Includes Hy-Duty, Wet-Cut, Dry-Cut and bench models.

18 MACHINE TOOLS—Walker-Turner Co., Inc., Plainfield, N. J. 36-page revised catalog G-5-3 contains new data on drillpresses and metal cut-off radial machines. Includes grinders, polishing lathes, motors, transmission equipment and price list.

19 CRANKSHAFT GRINDER—Winona Tool Mfg. Co., Winona, Minn. 2-page bulletin describes Intheblock crankshaft grinder which handles all crankpins from 1⅛ to 2⅜ in. long and 1.6 to 2½ in. dia.

20 TAPPERS—Western Machine Tool Works, Holland, Mich. 24-page catalog 4612-2X on Garvin No. 2X automatic tapping machines equipped with Timken tapered roller bearings. Includes specifications and repair parts.

21 TAPPING—The Charles L. Jarvis Co., Middletown, Conn. 8-page bulletin describes Torquomatic torque-driven tapping tool which fits on any drillpress or tapping machine and operates without pressure on tap itself. Capacities of various models are to ⅝ in.

TOOLS AND ACCESSORIES

22 GRINDING WHEELS—Electro Refractories & Alloys Corp., Buffalo 2, N. Y. 64-page catalog covers grinding wheels, giving general data, descriptions, price list and other data. Included is calculating rule for determining wheel speed.

23 ABRASIVES—Clover Mfg. Co., Norwalk, Conn. Two 4-page bulletins, "Testing Coated Abrasives" and "Coolants for Abrasive Belts," describe, respectively, work-value testing of abrasives, and the use of glue-bonded belts with oil coolant vs. "waterproof" belts with water coolant.

24 UTIL-A-TOOL—Templeton, Kenly & Co., Chicago 44, Ill. 4-page bulletin describes Simplex Util-A-Tool used for pulling, pushing, spreading, bending, clamping and lifting. Applications include pulling pulleys, gears, center wheels.

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25 COMPARATORS—Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford 1, Conn. 16-page bulletin 487 describes and illustrates Air-O-Limit comparators which use air as a gaging medium. Readings can be accurate to 0.0001 in. or less.

26 MILLS—Severance Tool Industries, Inc., Saginaw, Mich. 28-page catalog 16 describes Midget Mills and four other tool types: deburring groups, tube-cutter group, countersink group and miscellaneous types.

HEAT-TREATING AND WELDING

27 WELDERS—Weldex, Inc., Detroit 10, Mich. Series of bulletins describes spot welders including air-operated rocker and plunger type and other manually and automatically controlled types.

28 WELDING CONTROL — Westinghouse Electric Corp., Pittsburgh 30, Pa. 18-page booklet B-3839 on Synchro-Trol line of synchronous-precision sec. resistance welding controls. Also describes Weld-O-Timer line of nonsynchronous controls.

29 TEMPERING—Surface Combustion Corp., Toledo 1, Ohio. 4-page bulletin SC-133 describes tempering in standard rated furnaces such as convection, oven and pot types. Illustrates Conjecto-Firing principle.

30 FOUNDRY EQUIPMENT—Hauck Mfg. Co., Brooklyn 15, N. Y. 12-page catalog 1043 covers oil- and gas-burning equipment for foundries. Includes oil burners for cupola lighting and mold drying.

PLANT SERVICE EQUIPMENT

31 TRUCKS, CASTERS, WHEELS—Thomas Truck & Caster Co., Keokuk, Iowa. Series of bulletins describes rubber-tired truck wheels, pneumatic and cushion wheels, handtrucks, pry trucks, barrel trucks and stands, and other equipment.

32 LIFT TRUCK — Lyon-Raymond Corp., Greene, N. Y. 6-page bulletin 220 covers hydraulic pallet lift truck. Capacity is 4000 lb. on truck for double-faced pallets and 3500 lb. on truck for single-faced pallets.

33 LIFTING MAGNETS — The Ohio Electric Mfg. Co., Cleveland 4, Ohio. 8-page bulletin 112 covers construction features of electric lifting magnets and magnet controllers. Includes sizes, capacities and applications.

34 BUILDING MAINTENANCE — Continental Asbestos & Refining Corp., New York 10, N. Y. 32-page catalog outlines specific maintenance problems. Describes floor maintenance products, protective and decorative coatings for buildings and installations, heat and water systems, cleansers, disinfectant and other products.

35 SAFETY PRODUCTS—The Protectoseal Co., Chicago 8, Ill. 8-page bulletin includes safety cans, tanks and containers for handling flammable liquids. Units have double perforated-metal fire baffles. Oily-waste cans also described.

36 FLOOR CLEANING—G. H. Tennant Co., Minneapolis 11, Minn. Three 2-page bulletins describe Model K industrial floor-cleaning machine. Unit is either gasoline- or electric-motor driven, uses revolving wire brush. Picks up dirt, grease, metal cuttings. Leaves smooth floor.

37 LIFT TRUCK—Trausitier Truck Co., Portland, Ore. 4-page bulletin describes two models of three-wheel lift trucks with 108-in. lift, 61-in. turning radius, and capacities of 1000 and 2000 lb.

38 STEEL SKIDS—The Union Metal Mfg. Co., Canton, Ohio. 4-page bulletin describes steel skid platforms and boxes with double corrugations for added strength. Also available is 4-page bulletin MH-806 illustrating 22 examples of use of metal skids, boxes and pallets.

PARTS AND MATERIALS

39 SCREW SAMPLES—United Screw and Bolt Corp., Chicago, Ill. Free samples include clutch-head screws and special bit. Screws can be driven by ordinary screwdriver. Also available is 12-page bulletin giving specifications and recommended hole sizes.

40 SYNTHETIC RUBBER — Chicago Rawhide Mfg. Co., Chicago 22, Ill. 32-page bulletin on Sirvene compounded elastomers discusses characteristics, gives formulae, applications in industry.

41 LOCKNUTS—Standard Locknut & Lockwasher Co., Inc., Indianapolis 4, Ind. 6-page bulletin gives specifications of locknuts and lockwashers for ball and roller bearings.

42 WIRE NUT SAMPLES—Ideal Industries, Inc., Sycamore, Ill. Free samples of wire nuts which are used to make wire joints. Literature giving specifications and information also included.

43 LUBRICATION ACCESSORIES — Alemite, Div. Stewart-Warner Corp., Chicago 14, Ill. 8-page index of centralized lubrication accessories includes bushings, check valves, pipe couplings, hose and tools.

44 BALL BEARING UNITS — Stephens-Adamson Mfg. Co., Aurora, Ill. 36-page catalog 845 describes Seal Master ball-bearing units which are self-aligning and pre-lubricated. Includes dimensions and load ratings.

45 PHOTOGRAPHIC PRODUCTS — The Di-Noc Co., Photographic Div., Cleveland 12, Ohio. 20-page bulletin includes Dinographic film, for making comparators, Dinoreflex film for templets, and Dinocloth, a sensitized tracing material.

46 FLOCK—Behr-Manning, Troy, N. Y. 10-page booklet on flock and flock finishing contains 24 color-sample swatches and gives information on adhesives and methods of applying adhesives and flock to various surfaces.

47 STANDARD PARTS—George P. Bub & Son, Cleveland 2, Ohio. 8-page catalog 2 describes standard parts including quarter-turn screws, washers, locating keys, hand knobs and jig feet.

48 CUTTING FLUIDS—D. A. Stuart Oil Co., Ltd., Chicago 23, Ill. 36-page booklet, "Cutting Fluids and Coolants" consists of four technical papers by authorities in the cutting-fluid field.

49 ROTARY PUMP—John S. Barnes Corp., Rockford, Ill. Catalog gives specifications and design features of Constant-Flo rotary gear pumps. Units are self-priming and self-lubricating.

50 CONTROL—The Brown Instrument Co., Div. Minneapolis-Honeywell Regulator Co., Philadelphia 44, Pa. 56-page catalog 8302, "Industrial Control Devices," describes electric and pneumatic automatic control systems. Includes schematic diagrams, dimensional drawings, specifications.

51 FLUID POWER—The Oilgear Co., Milwaukee 4, Wis. 2-page bulletin 90011 gives piping recommendations for Oilgear fluid-power systems. Includes information on joints, connections, flexible hose, tubes and fittings, and installation.

52 PUMP GOVERNORS—Lealie Co., Lyndhurst, N. J. 16-page bulletin 463 on pump governors for control of reciprocating, turbine and motor-driven pumps. Engineering, maintenance and operating data included.

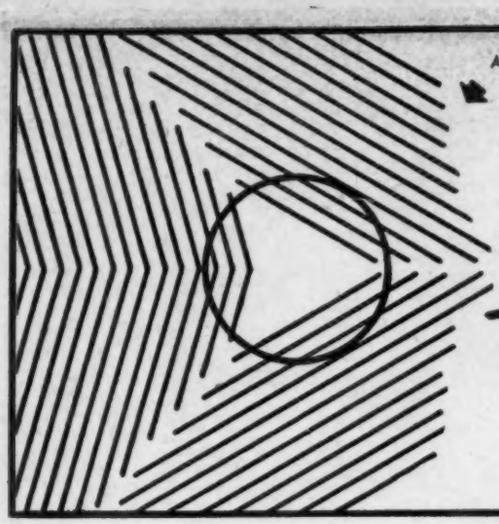
53 STEEL—The American Rolling Mill Co., Middletown, Ohio. 20-page bulletin describes Armco special-purpose steels including stainless steels, such as sheets, wire and bars; coated sheets, such as galvanized, Zincgrip and aluminized; and other products such as drawing steels and electrical sheet steels.

MISCELLANEOUS

54 FORGING—The Steel Improvement & Forge Co., Cleveland 14, Ohio. Chart provides means to determine commercial tolerances for any style, shape or weight of forging up to 500 lb.

55 PRESS PROOFS—The Hydraulic Press Mfg. Co., Mount Gilead, Ohio. First issue of monthly booklet, "Press Proofs" (which is devoted to the business of making money), discusses the difference between depreciation and obsolescence of machinery and includes advice for comptrollers.

56 PRODUCT DESIGN—Designers for Industry, Inc., Cleveland 13, Ohio. 20-page booklet, "DFI Planned Products Service," describes 12 integrated industrial services offered by the firm. Includes case histories.



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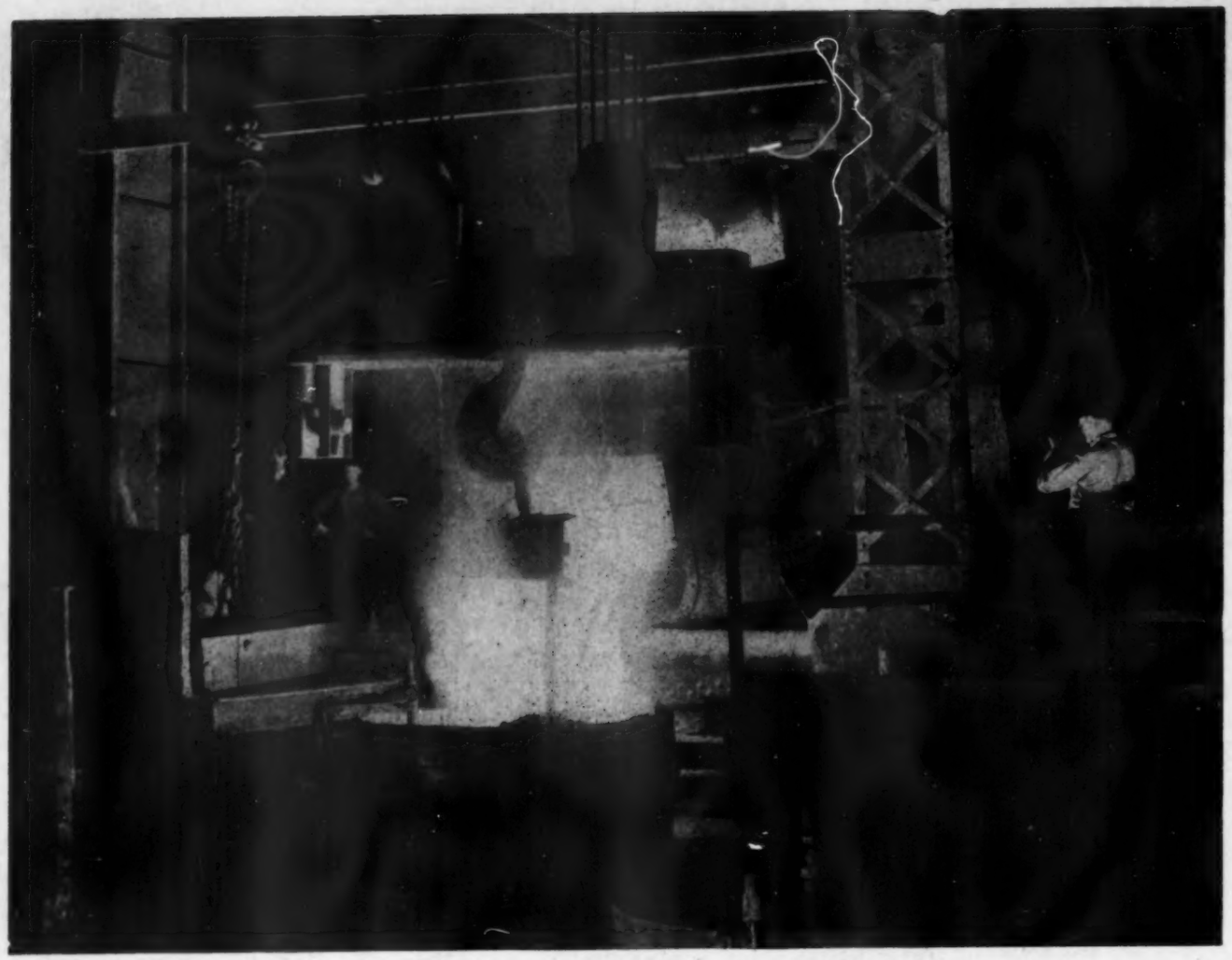

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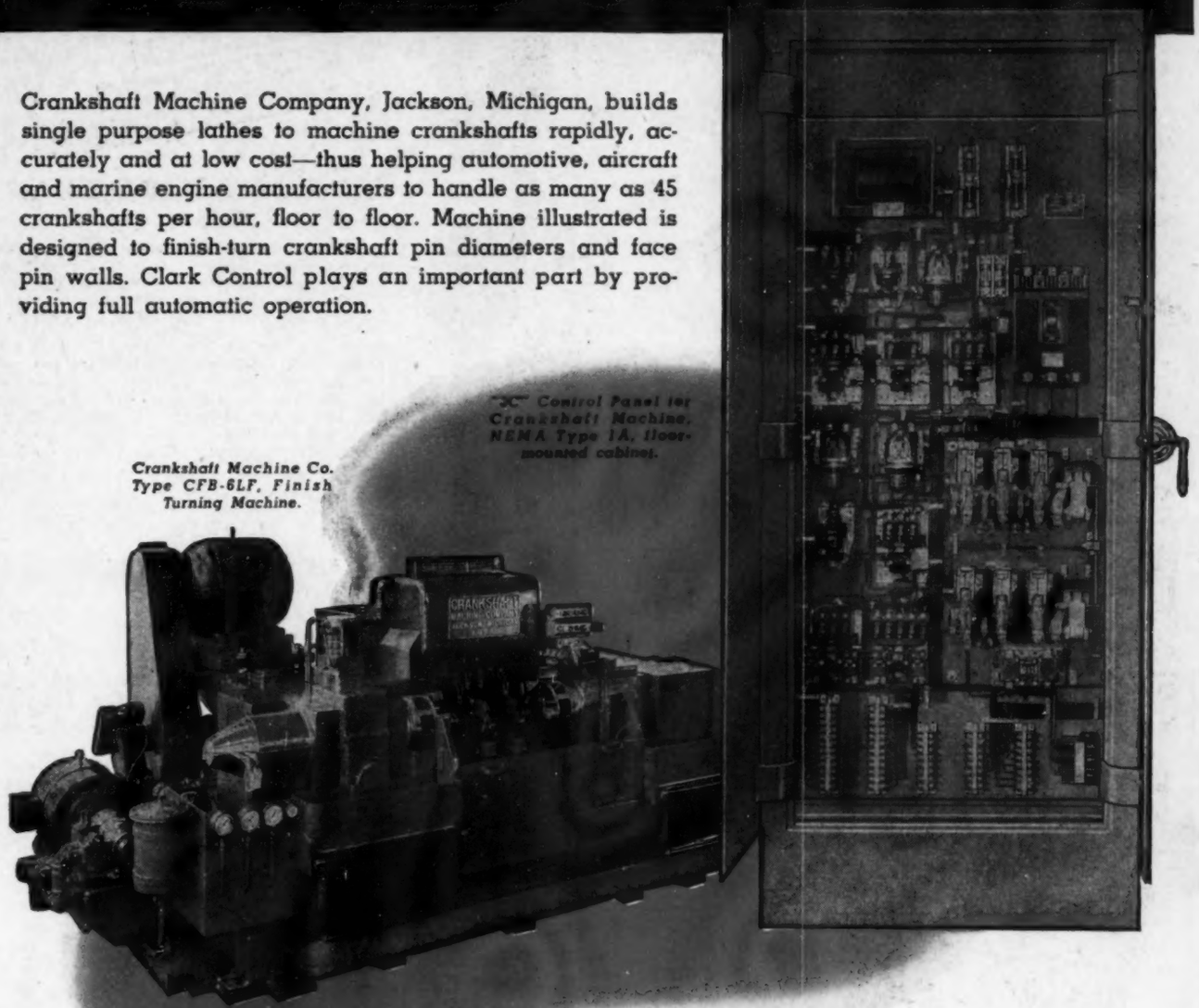

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Crankshaft Machine Co. Type CFB-6LF, Finish Turning Machine.

After crankshaft is placed in chucks and starting lever engaged, every operation is automatic. Chucks and steady rests close hydraulically, crankshaft starts to rotate and the table moves to cutters. When machining is finished, table travels to starting position, rotation stops and chucks open. Special controls stop machine if hydraulic pressure drops below required level. If main motor stops, table automatically backs away from cutting tools and machine stops. "3C" Bulletin 100 Type D push-buttons on machine are used for inching during setting up, and for emergency stopping.

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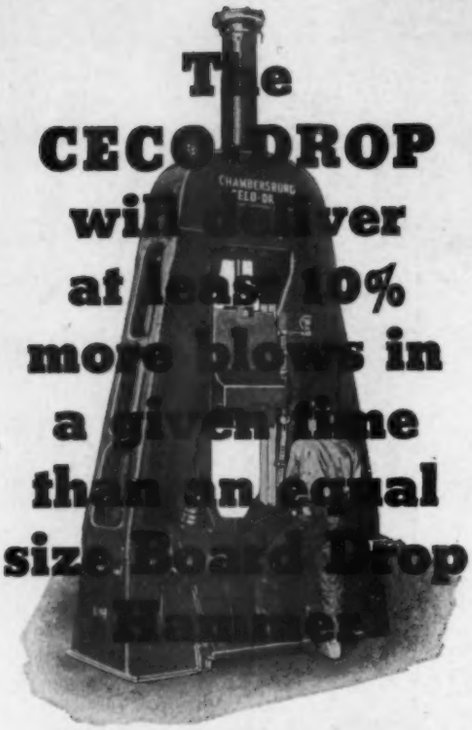

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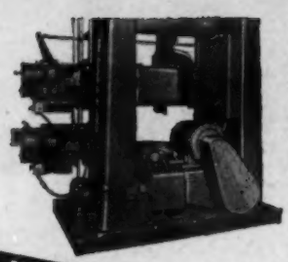

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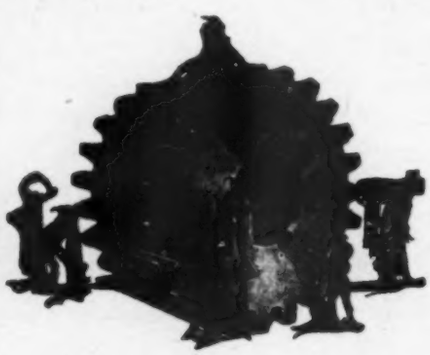

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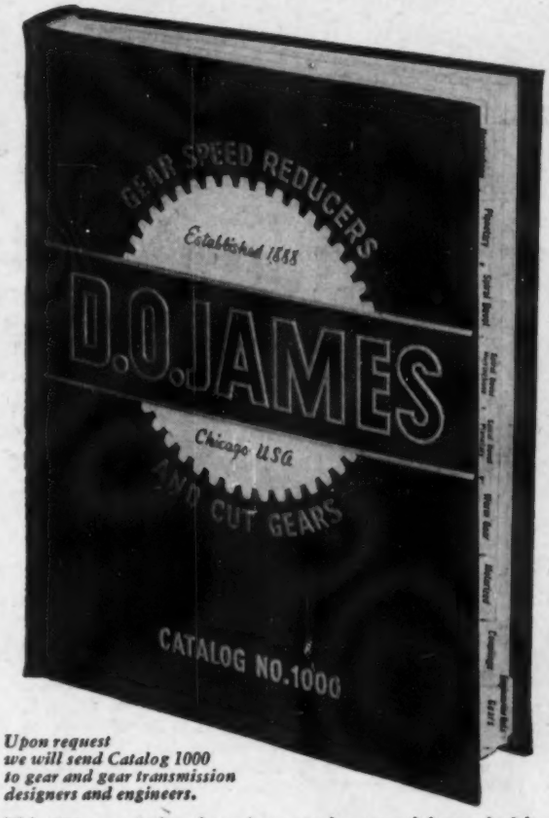

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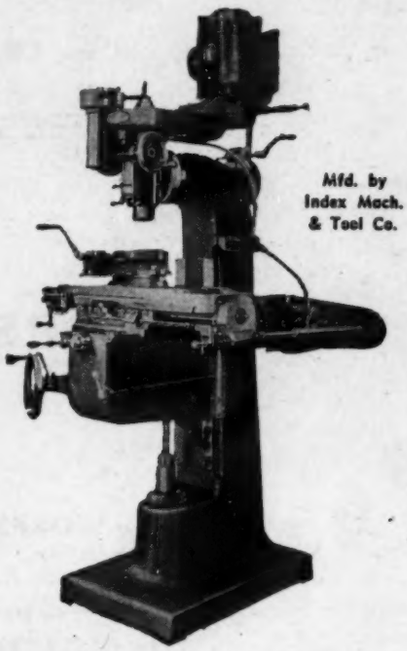

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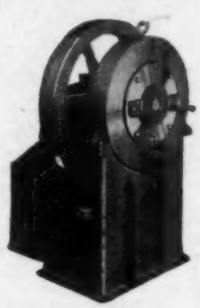

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— with 4000 forceful squeezing hammer blows per minute—makes metal tougher and more elastic. Send for booklet—"The Torrington Swaging Machine."

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In keen competition for vital parts of top quality at lowest practical cost, forgings take a leading place in machine design. Erie Hammers, product of over a half century of hammer building "know how", plus experienced hammer-gangs, are meeting the most exacting forging demands of diversified industry. Bulletins on Erie Steam or Board Drop, Double or Single Frame Forging Hammers and Trimming Presses are yours for the asking.

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This old lap of ours was just made for you to drop your tooling problem in. We've been at it for years. Try us on yours, and get that machine tool trouble off your hands.

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"Standard" TURKS HEADS

ROLL 4 SIDES IN ONE OPERATION

"Standard" Turks Heads (adjustable draw plates) draw rod accurately to triangular, rectangular and special shapes—both plain and ornamental. All four sides are rolled simultaneously. "Standard" Turks Heads, universal and plain types, are available in a wide range of capacities, with friction or power driven rolls, tandem mountings and special attachments. Widely used as running-in guide and sizing facility on pay-off side of rolling mills and wire flattening mills. Write for Bulletin TH.

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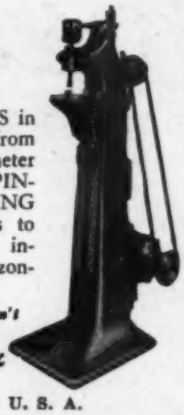

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They save 50% on sawing, filing and lapping operations, easily maintaining .002" limits. Ask for special bulletin—also circulars on Drill Grinders, Point Thinners, Tool and Cutter Grinders, Face Mill Grinders and Tool Bit Grinders.

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All Baumbach Die-Sets have demountable Leader Pins and Bushings. This exclusive feature permits removing Leader pins for machine work on the die shoe and assures reassembly without loss of alignment. A big time and trouble saver. Write for Catalog.

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SAVES TIME MAKES MONEY
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CUTS ANY SHAPE CUTS ANY SIZE
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THROATLESS SHEARS

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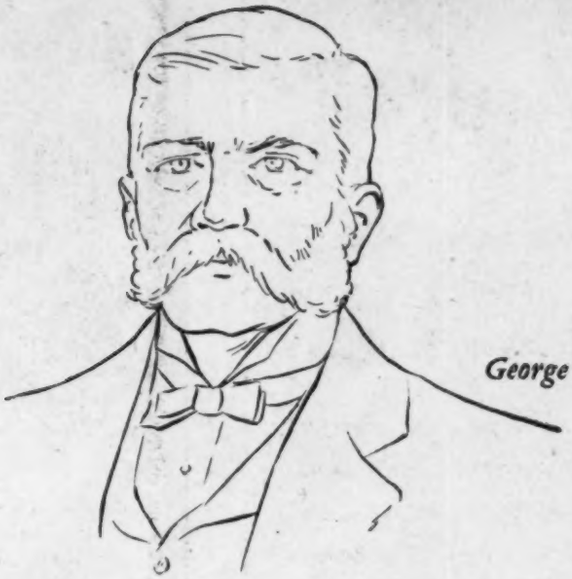

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● The name George Westinghouse is an honored name not only in industry but in many industries. First prominent through the invention of the air brake, the name and genius of Westinghouse is associated with hundreds of other products known for utility, performance and service to people everywhere. Niagara presses, shears and other machines for working sheet metal are important in the production of an infinite number of products bearing the Westinghouse name. Men responsible for production economy are invited to look into the advanced design of Niagara machines.

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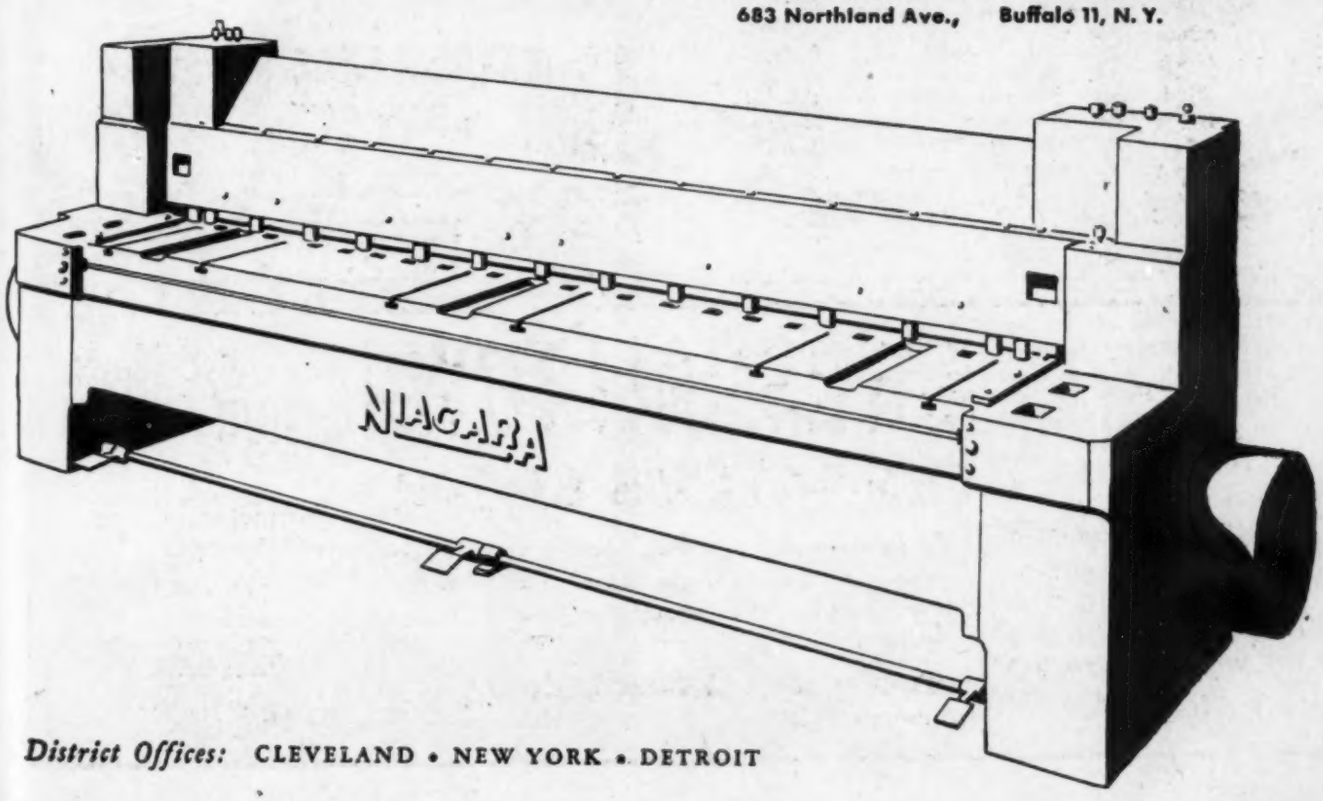

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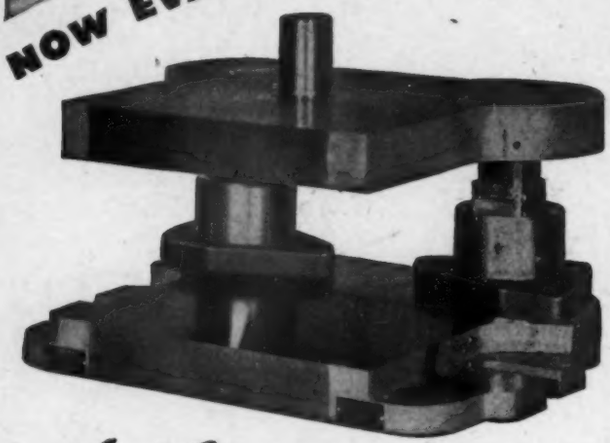

New Speed and Accuracy

...with MICROLEX ANTI-FRICTION DIE SETS

Now Evans offers you the perfect companion pieces for expensive tools and dies. They are Microlex Anti-Friction Die Sets.

Microlex Die Sets have ball or roller bearing guide pins. As a result they make it possible for you to produce parts faster, to tighter limits of accuracy and reduce scrap loss.

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Anti-friction guide pins reduce die setter's time . . . enable you to get into production quicker . . . permit fast press speeds. Microlex Die Sets eliminate all down time caused by bound, scored or galled pins. Bearings on these sets have pre-load of .0015" which prevents all possibility of play between guide pins and bushings . . . assures positive accuracy.

You don't have to wait to cash in on the profitable advantages offered by Evans Microlex Die Sets. A large number of sizes are ready for immediate shipment. Phone or write today. We will be glad to help you select the set that meets your exact needs.

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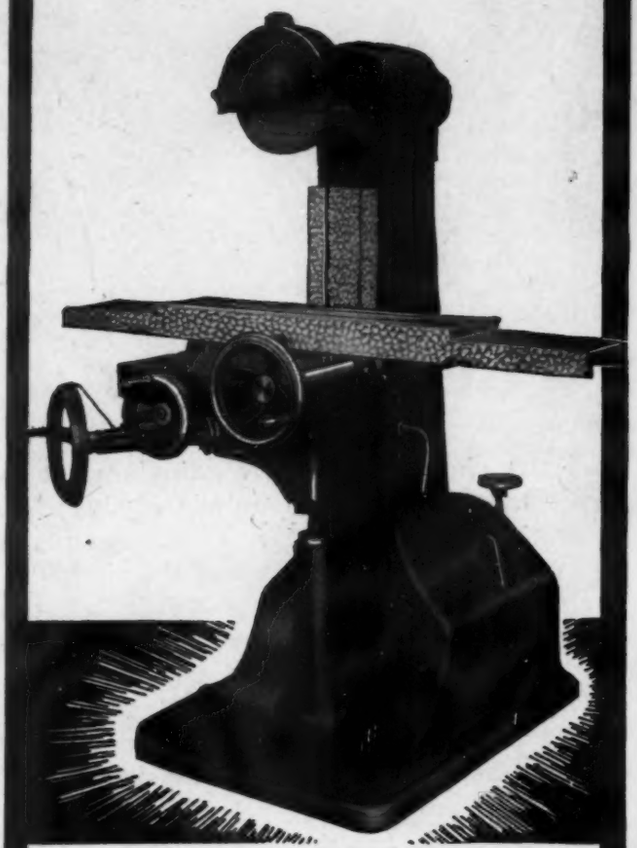

EXTRA LARGE CAPACITY
6" x 24" x 12"
HEIGHT 52"
WEIGHT 850 lbs.
2 SPINDLE SPEEDS
2600 and 3500 R.P.M.

$650.00

Complete with motor of standard Current characteristics F. O. B. Factory.

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(TUNGSTEN CARBIDE)

Drawing Dies

Talide Tungsten Carbide Dies outwear steel dies at least 20 times, and in many applications, the ratio is as high as 50 to 1.

Made from the hardest metal known, with great compressive strength, the wear on these dies after thousands of draws is almost negligible. Talide Metal needs little redressing, a factor which reduces down time by over 50%.

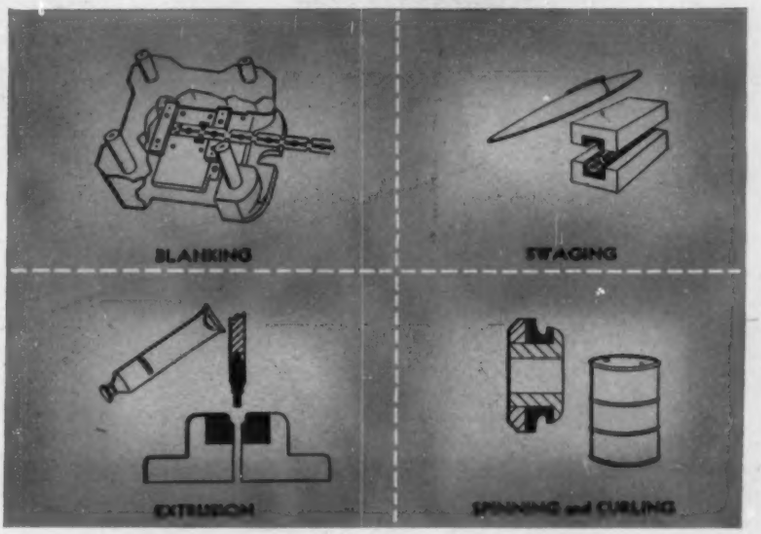
You can increase production, too, by taking much heavier drafts with Talide Dies, and by using the same Talide Drawing Die for two operations.

Talide Dies take and hold a brilliant finish, which imparts a better finish to your product and helps to eliminate scoring, galling, or pick-up. Scrap is reduced to practically nothing which increases by many thousands the number of pieces passing rigid inspection.

Original cost higher? Yes, but as for the advantages, the chief engineer of a prominent stamping plant has this to say:

"Our past experience proves to us that the original cost of Talide Dies is offset many times by the economy of long production runs."

Production men adapt Talide Dies for long production runs where steel dies wear out too fast or the service is too severe. See the illustrations here of typical applications of blanking, swaging, extruding, spinning and curling. The applications are almost endless. Write us about your particular application.



TALIDE METAL *meets every requirement*

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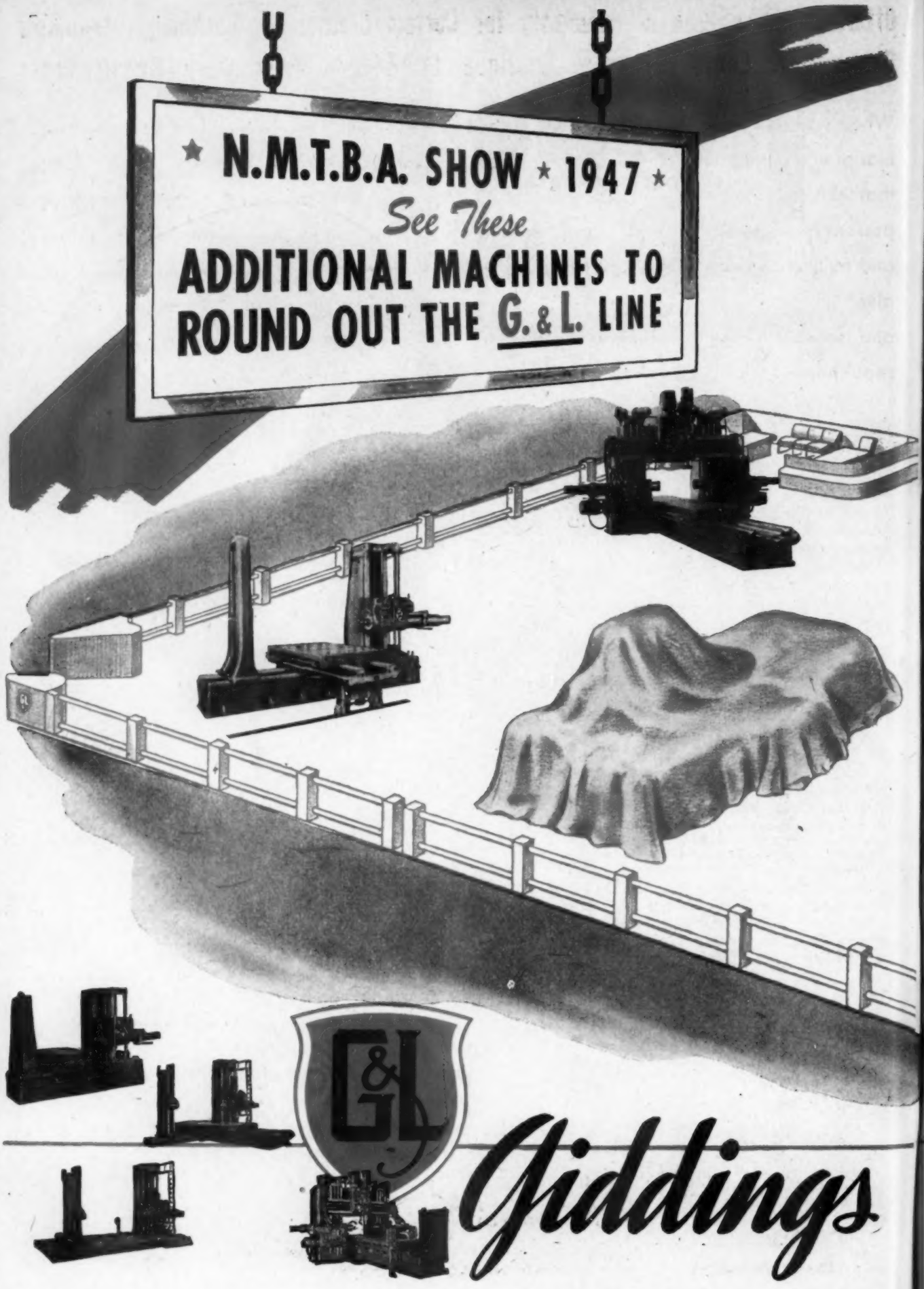
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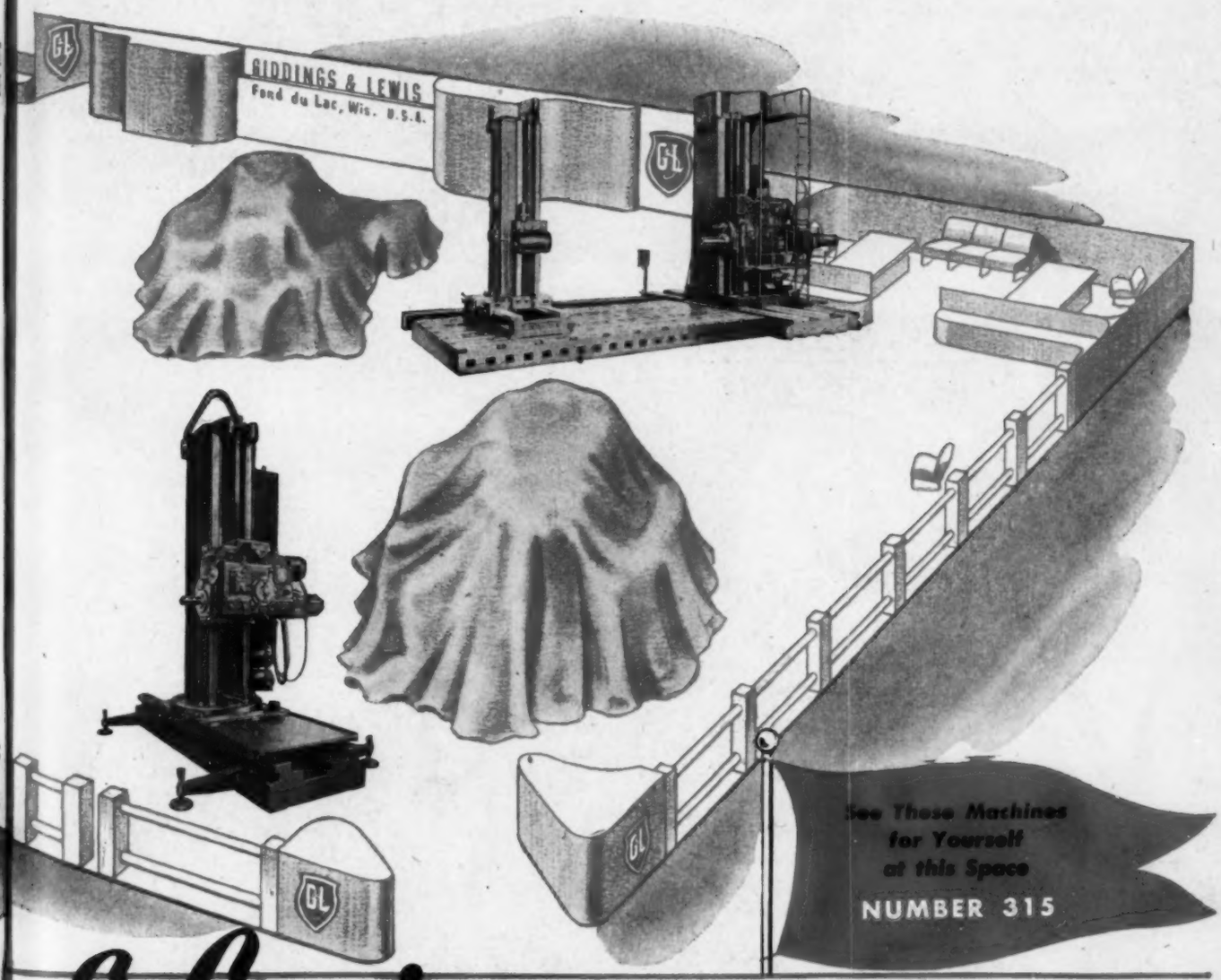
ADDITIONAL MACHINES TO
ROUND OUT THE G. & L. LINE
G&L
Giddings

Offering a New High in Versatility for Certain Classes of Machining...*Standard* Giddings & Lewis Machines Continue to Handle Most Work Requirements

When you see these G. & L. machines at the National Machine Tool Show, you will agree that this equipment can supplement your present and future horizontal boring, drilling and milling machines. They are designed to give greater accuracy at modern feeds and speeds to meet changing production requirements on specific types of work.

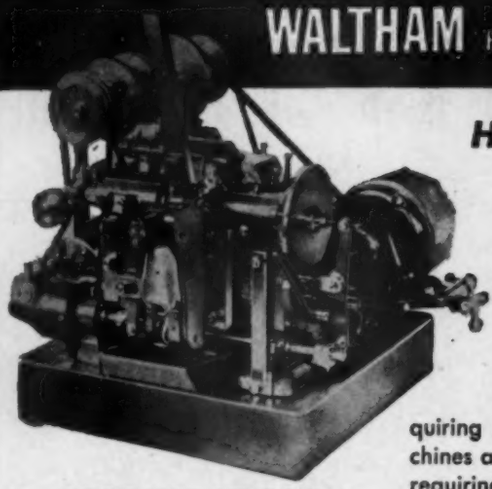
Yes, look to G. & L. for sound, basic, progressive ideas. See how this far-sighted company incorporates such practical ideas in new equipment developments. Observe the way these *added* models can be coupled in performance with horizontal boring machines, thus enabling you to produce more at greater profit.



& Lewis MACHINE TOOL CO.

138 DOTY STREET • FOND DU LAC, WISCONSIN

WALTHAM PINION & GEAR CUTTING MACHINES

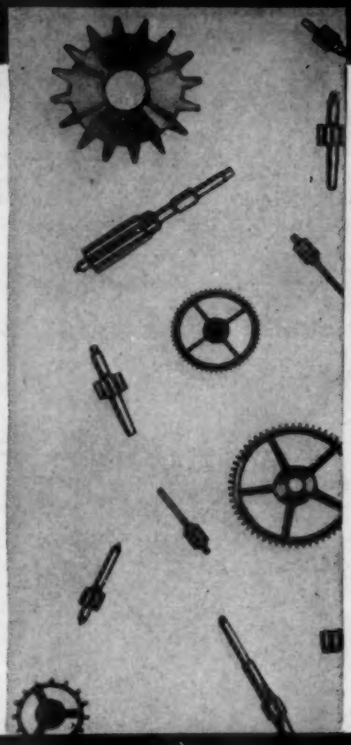


Highly productive—fast and accurate

These machines—made in single-cut, multiple-cut and magazine-feed types—are designed for the fast, precision production of gears and pinions for watches, instruments, fuses, etc. They are simple to operate, requiring no special skill. Magazine-feed machines are fully automatic, the other machines requiring positioning of blank and starting by hand.

Drive for these machines is either from countershaft or by individual motor. On motor driven machines, V-belts drive cutter spindle, worm shaft and pump.

Illustrated literature and detailed specifications are available promptly on request.



SPECIFICATIONS

PINION MACHINES

Diameter capacity, approx. ½"
Coarsest pitch about 32 D.P.
Strokes of Work slide for pinions—.24" to .45"
Strokes of work slide for stacked gears —.85 to 1"

GEAR MACHINES

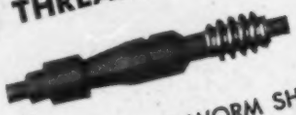
Pitch diameter, capacity 1½"
Strokes for work slide, .40", .65", 1.00", 1.25"

WALTHAM MACHINE WORKS
WALTHAM, MASS.

WALTHAM
TRADE MARK REGISTERED U.S. PAT. OFF.

Proof of LOWER PRODUCTION COSTS
with REED Triple-Die
Precision Thread Rolling!

800 THREADS AN HOUR



Part: SPEEDOMETER WORM SHAFT
Thread: ¼"-16 WORM
Material: MS-73 COLD DRAWN STEEL

Rolled on the **REED Cylindrical-Die THREAD ROLLER Model A22**

For complete specifications, write for Bulletin A22-1.

Prove it to your own satisfaction! Send us specifications of your work and let us roll samples. We will furnish production estimates and equipment costs.

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Formerly ROLLED THREAD DIE CO. and REED SMALL TOOL WORKS
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The excellence of Sterling Grinding Wheels is built upon many "plus factors." One important one is Sterling's famous "H" Bond which has been so successfully used with tool-room wheels. Results prove that this carefully developed bond imparts something extra to each wheel—makes it do a better job longer and faster!

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Still another "plus factor" is available in Sterling's committee method of selecting grinding wheels for special purpose. Not one grinding expert, but five or six, determines the correct wheel to solve your unusual, troublesome problem. Around a table, where several ideas can be exchanged, that's where your special Sterling Grinding Wheel is developed in conference between laboratory, engineering, and manufacturing executives.

There are many more Sterling Grinding Wheel "plus factors" waiting to work for you. May we tell you more about them?

• A complete outline of the correct wheels to use on hundreds of grinding jobs is available to you in the Sterling Specification Selector. May we send your copy?

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THE WHEELS OF INDUSTRY

QUANTITY - and *Precision* with GARDNER *Double* GRINDING

HERE is another example of extremely close tolerances and peak production grinding TWO faces at ONE setting of steel valve plates and connecting rods; and "back-to-back" grinding of compressor heads — all parts of a well-known refrigerator unit.

The machine is a GARDNER No. 120A-23" GRINDER carrying an hydraulically-operated roller gun-type fixture. All pieces are handled in 2 cuts — roughing and finishing.

TOLERANCES: for the finish cut average .0005" to .001" for flatness, and .002" for uniformity.

PRODUCTION: 4 to 6 pieces per minute, on connecting rods and valve plates.

8 to 10 pieces per minute on compressor heads. These parts, being ground on one face only, are held in a "back-to-back" fixture, which permits grinding 2 parts at one setting.

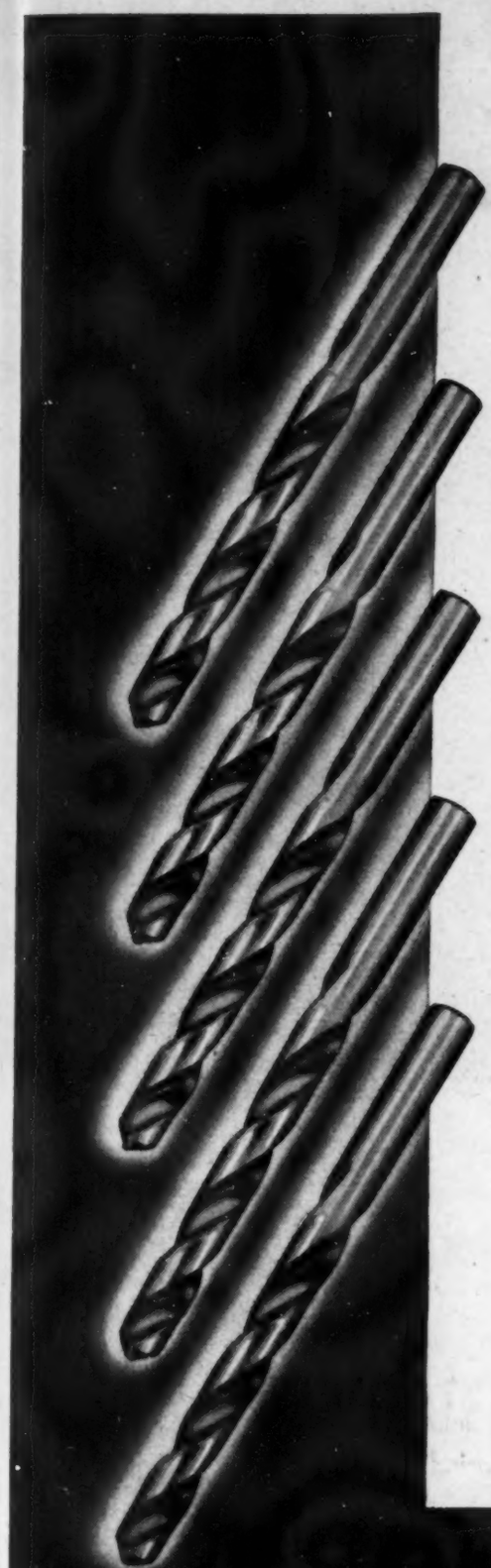
Check the possibilities for closer tolerances and higher production on YOUR flat surface jobs—

Write for 8-Page GARDNER-GRINDING Bulletin!

GARDNER - GRIND YOUR *Flat* SURFACES

GARDNER MACHINE COMPANY

410 East Gardner Street . . . . Beloit, Wisconsin, U.S.A.



DEPENDABLE DRILL PERFORMANCE

It is easy enough to put a few drills in the shop and get a favorable report on their performance. But what about the next order . . . and the next? Will *every* drill in *every* lot give you a consistently satisfactory performance? They will if they are ACE Drills.

ACE Drills have a *uniform* high quality because the flutes are ground into solid, uniformly hardened drill length bars of high speed steel. Uniform hardness is obtained by passing mill length bars through a 22 foot long hardening furnace in a continuous line . . . bar after bar.

The bars enter and leave the furnace through small flame-sealed openings which eliminate sudden rushes of air when doors are opened as they are in batch type hardening processes. Uniform furnace conditions are thus assured. The continuous feed of the bars in the ACE process exposes each part of each bar to identical treatment resulting in thoroughly uniform heat treating. Thus ACE Drill hardness is uniform to within one-half ROCKWELL point giving ACE Drill users consistently dependable drill performance.

2256

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A UNIVERSAL RAIL TYPE DRILLING MACHINE

- Spindles have angular adjustment through 90 degrees.
- Center distances from 15½" to 62" when vertical.
- Hydraulic feed with either plain or step by step control for deep hole drilling.
- Heads are easily and quickly moved along rail by means of handwheel and rack and pinion.
- Angular adjustment of spindles is conveniently and quickly made by means of worm and worm wheel and graduated ring.
- Nema Motor drive.

LELAND-GIFFORD

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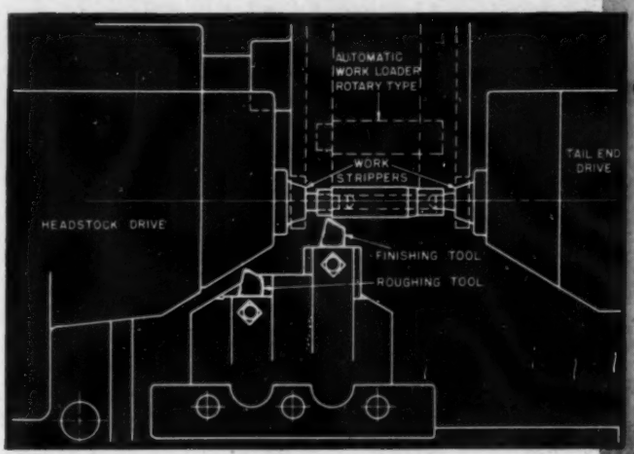
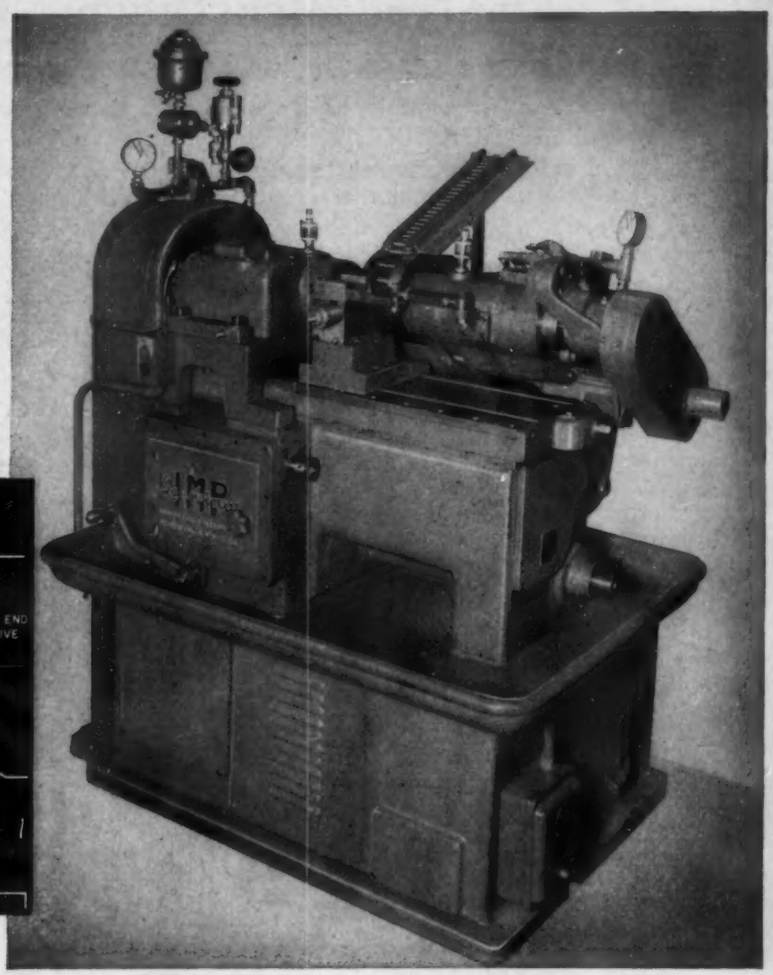
MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK

COST ON VALVE GUIDE JOB REDUCED 73.6%



Tooling layout for turning Valve Guides on Lathe illustrated at right.



Problem: **To reduce cost of rough and finish turning valve guides.**

Solution: **The Lo-swing IMP Automatic Lathe was selected for this job and fitted with a new type Rotary loader and a complete new adaptation of tooling. This lathe is equipped with special revolving head and tailstock spindles and the advantage of this double-end drive is two-fold: 1—Since the piece is driven from both ends much coarser carriage feeds are possible, thereby considerably increasing production; and 2—inasmuch as both spindles are driven, there is no wear on the revolving centers.**

The machine is entirely automatic. Valve guides which have been previously bored to size are placed in a loading chute and fed by gravity into openings in the Rotary loader. The loader indexes the pieces to the proper position where they are automatically picked up by the continuously revolving spindles of both heads.

The OD is rough and finish turned in the same operation with two separate carbide tools, each having its individual feed. The finish turning tool begins cutting after the roughing tool has been relieved from the work, thereby assuring close concentricity between the bore and the finished diameter.

On high production jobs operator fatigue is an important item . . . automatic work handling permits full mechanical efficiency of equipment and reduces accident hazard.

The Rotary type loader assures complete control over the fast revolving pieces eliminating danger to the operator and damage to the pieces which are completely stationary by the time they reach the discharge chute.

One operator attends two of these IMP Lathes and produces 73.6% more work per hour than was produced on the former single machine with hand loading. If *your* per piece costs are too high, maybe Seneca Falls can help you.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

PRODUCTION COSTS ARE LOWER WITH Lo-swing

Adjustable

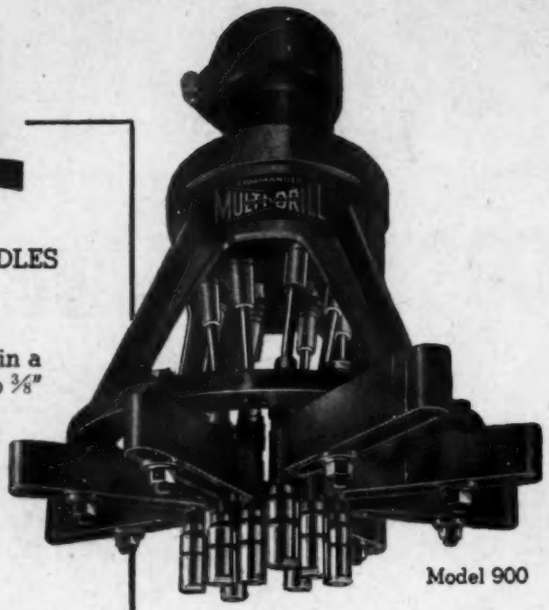
MULTI-DRILL

for *Production* Drilling

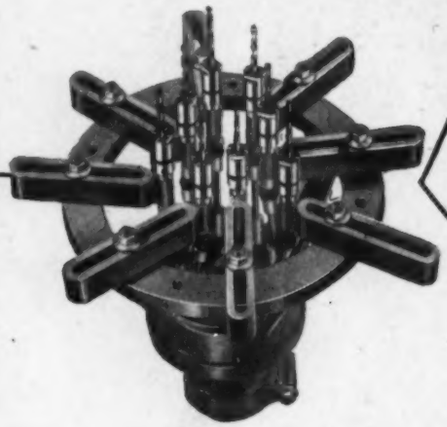
9" DRILLING AREA—AVAILABLE WITH 2 TO 8 SPINDLES

- Designed for accurate, high speed production drilling
- RUGGED CONSTRUCTION
- Quick, easy adjustments to **any** hole pattern on or within a 9" circle; ½" minimum center distances; Drill sizes ½" to ⅜"
- Special adaptations available

MULTI-DRILLS are made in other sizes and models
Write for details and name of your nearest Distributor



Model 900



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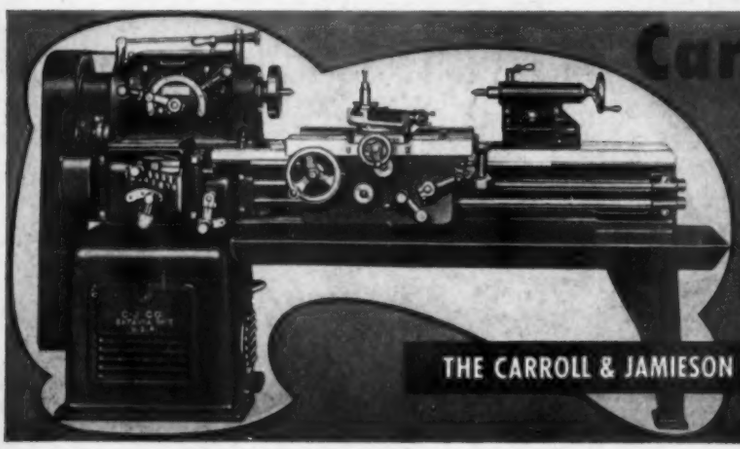

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16" LATHE

12 Speed Geared Head Motor Drive
Timken Mounted Spindle
Modern Design—
Liberal Dimensions
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in Speed and Accuracy

FOR MILLING JOBS!

Kent-Owens Machines "have what it takes" to get your milling jobs done *right!*

They're rapid . . . accurate . . . efficient. Designed to help you *produce more* . . . with *lower costs!* Rugged and dependable in every detail. Practical and versatile.

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No. 1-14 Milling Machine
Table, 32" x 9"
Table travel, 14"

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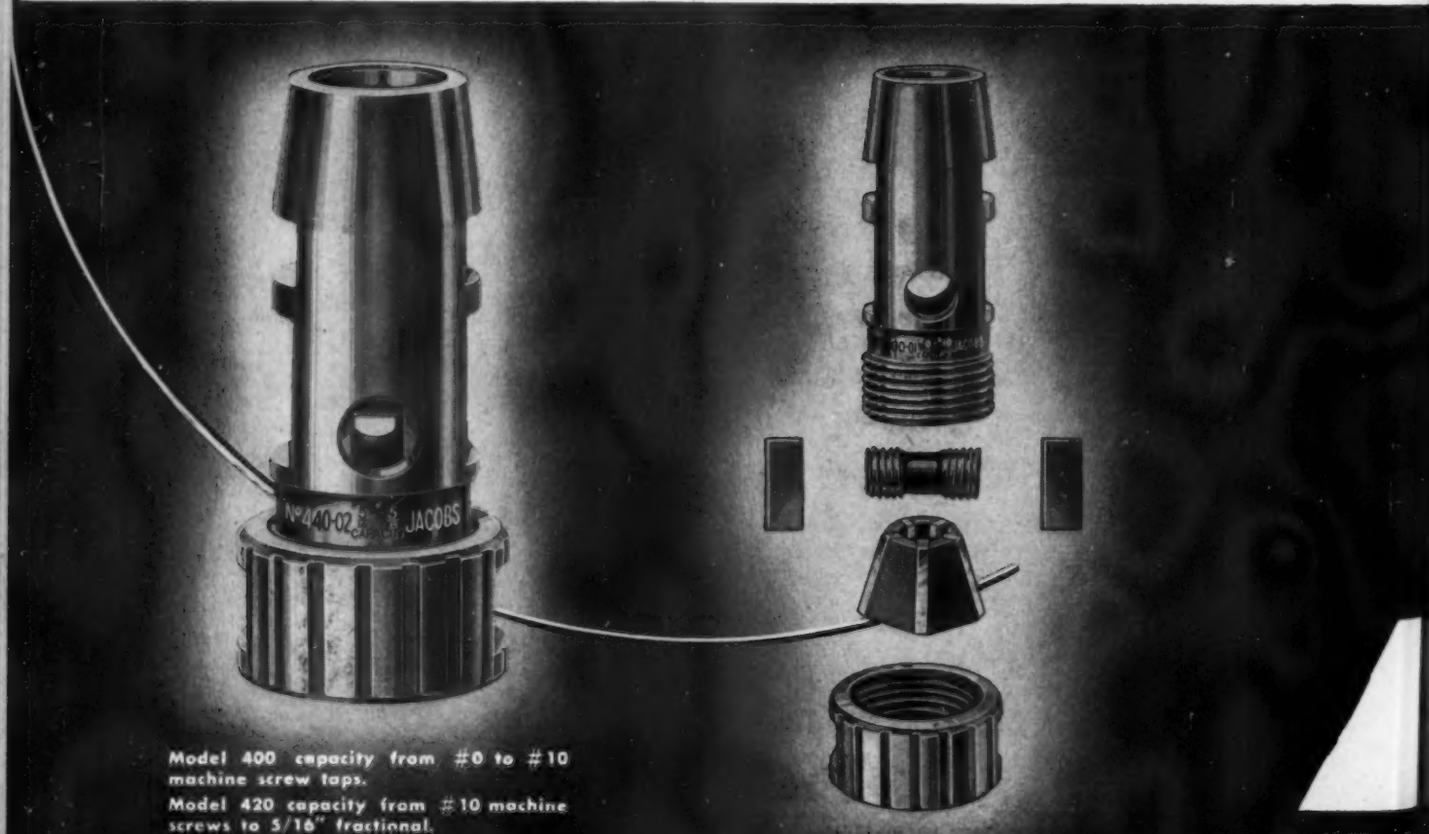
GRAND RAPIDS Joseph Monahan			

Here it is...

RUGGED, light and compact—featuring positive drive and accuracy—this new type Tap Chuck is ideal for use on all types of tapping heads and tapping machines. Lightness and compactness mean less torsional inertia on the spindle which contributes greatly towards reducing tap breakage—particularly in bottom tapping—and allows for quicker stopping and reversing of the tapping spindle. The heart of this chuck is the Jacobs Rubber-Flex Collet. Made as a single unit, the Rubber-Flex Collet is comprised of several hardened steel jaws permanently bonded into a synthetic rubber body. All working surfaces of this collet are precision ground after moulding and the collet is centralized by a ground conical bore in the chuck body, assuring extreme concentricity. Because the jaws of the Rubber-Flex Collet are rigid steel pieces ground to a fixed shape and all flexing is assumed by the resilient synthetic rubber web separating the jaws, parallelism of the jaw bites is assured throughout the entire range of the collet so that the smallest tap is held as firmly and as accurately as the largest.



Model 400 capacity from #0 to #10 machine screw taps.

Model 420 capacity from #10 machine screws to 5/16" fractional.

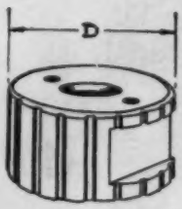
Model 440 illustrated actual size, capacity 5/16"-5/8" fractional taps.

...BRAND NEW!

A STRONG, LIGHTWEIGHT TAP CHUCK

MADE WITH THE JACOBS RUBBER-FLEX COLLET

CHECK THESE SPECIAL FEATURES!

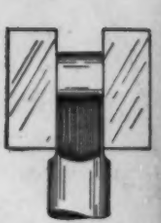


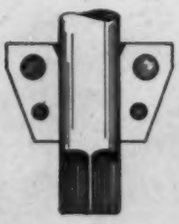
SMALL DIAMETER

Combined with light weight keep to a minimum the torsional inertia which a holder builds up on a tapping spindle.

POSITIVE DRIVE

Floating back jaws provide positive drive on all sizes of tap squares.



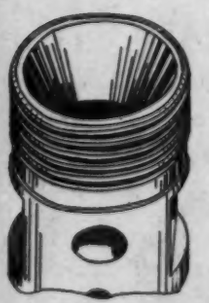


GREATER GRIPPING POWER

The parallel bite of the Rubber-Flex Collet prevents disengagement of the positive drive.

SIMPLIFIED TAP CHANGING

Quarter turn of cap and the jaw screw disengages tap from chuck. Large sight hole facilitates tap changing.

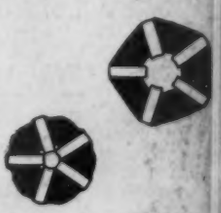


GREATER ACCURACY

Completely ground collet and chuck body give unusual control of run-out.

WIDE COLLET RANGE

One collet takes all taps in its range. No individual sleeves or changing required.

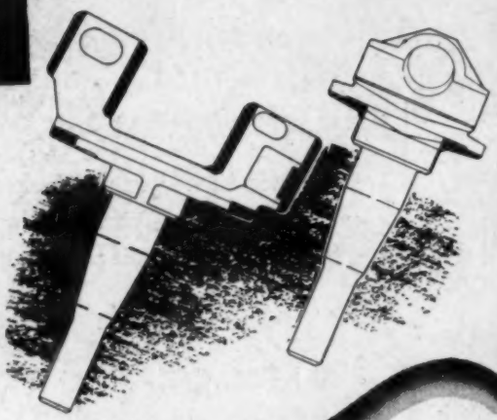


For prices and complete specifications of this new chuck ask your Industrial Supply Distributor for Jacobs catalogue 47-T.

Jacobs Chucks

THE JACOBS MANUFACTURING COMPANY
HARTFORD 2, CONNECTICUT

MICHIGAN TOOLED KAISER-FRAZER FOR *Complete Broaching* OF THIS STEERING KNUCKLE



Broaches, Broach Holders and Pneumatic Fixtures were designed, built and followed in Production by Michigan

Illustrated is one of 4 machines equipped by Michigan. Shows dual ram set up with pneumatic fixture at left in operative position, fixture at right in loading position. 16 surfaces and the king pin hole are broached to final finish in five passes.

What makes this a story? Just that Michigan can do the same for you—start with the part print and machine and place the job in production.

Let Michigan quote on your next job

MICHIGAN WILL *also* DO THE COMPLETE MACHINING OF YOUR PARTS

Michigan is also equipped with the largest machine shop of its kind to machine and broach production parts for you.

MICHIGAN BROACH CO.

10373 NORTHLAWN AVENUE • • • DETROIT 4, MICHIGAN

TWO WAYS TO BUY SPECIALTY STEELS

Does your plant require an unusual type of steel —one of an analysis or in a form not generally available? One way to get what you want is to look through your file of catalogs and directories in search of a supplier who might have what you want. A much simpler way is to call or write JESSOP and describe your needs. Our complete and diversified line of specialty steels enables us to meet your requirements exactly.

JESSOP Specialty Steels include stainless steels of all types, both solid stainless and stainless-clad; tool and die steels for every purpose, including "T & V" cast non-ferrous alloy and "Malta" carbide finished tools and dies; and such special items as precision ground flat stock, composite tool steel, and composite die sections. Remember—if it's a specialty steel, JESSOP has it.

JESSOP STEEL COMPANY

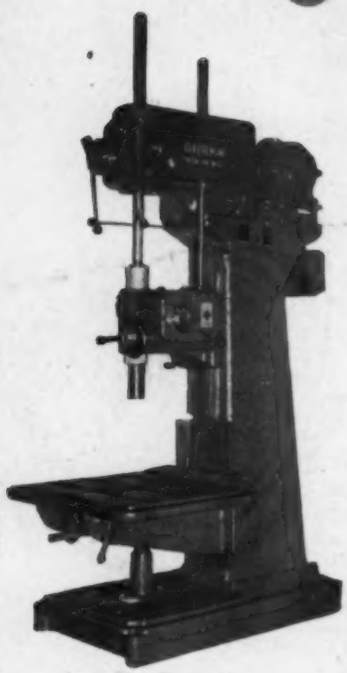
Washington, Pennsylvania

Tailor-made Specialty Steels

DETROIT WAREHOUSE: 3224 E. Jefferson Ave., Phone Fitzroy 1141

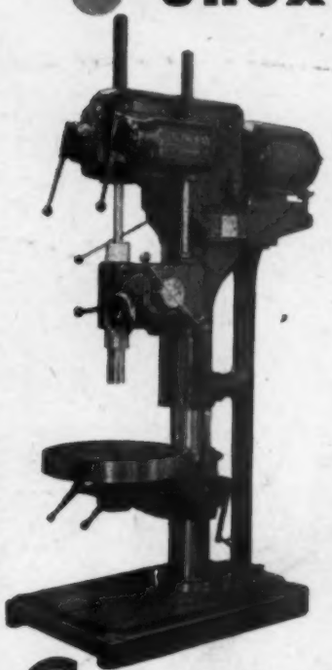
CLEEREMAN *for*

- high efficiency
- wide adaptability
- long working life
- unexcelled precision



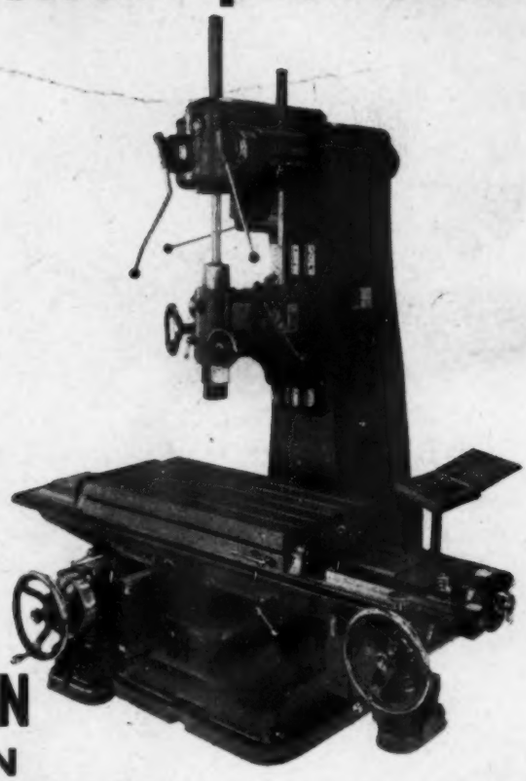
CLEEREMAN
BOX COLUMN DRILLING MACHINES

. . . meet all requirements of fast, accurate, low cost production. With controls within easy reach, the operator can produce *more* pieces, in *less* time, at lower cost. Also available with compound tables. Write for literature.



CLEEREMAN
ROUND COLUMN DRILLING MACHINES

. . . are designed and built to the highest standards . . . produce accurate holes at high speed and at low cost. All major controls are within arms' reach of the operator to improve efficiency of operation. Write for catalog.



CLEEREMAN
JIG BORERS

. . . bring you unexcelled accuracy in the production of jigs, fixtures, tools, dies, gauges. They are ideal for small lot production *without* previous layout, jigs, fixtures or special tooling — all at lower cost than any other method! Write for *new* catalog.

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Machinery & Engineering
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Affiliated with—

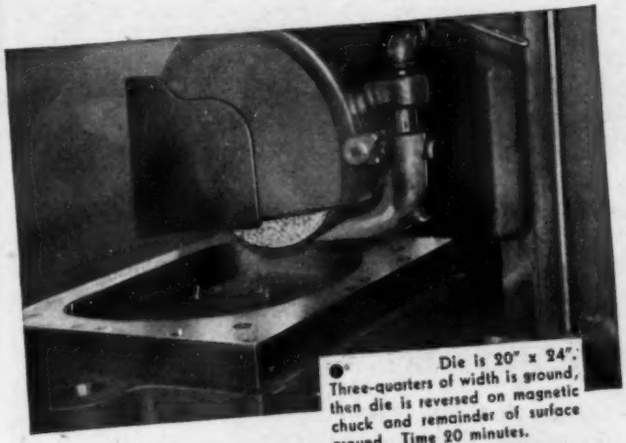
CLEEREMAN MACHINE TOOL CO. Green Bay, Wis.
BUILDERS OF PRECISION JIG BORERS & DRILLING MACHINES

'TIME OUT' FOR DIE RECONDITIONING HELD TO A MINIMUM *with the* *Mattison Grinder*

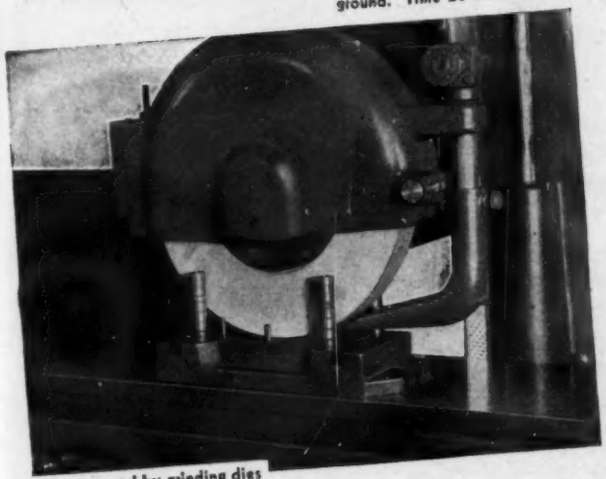
A GREAT variety of die work can be speedily and easily handled on the Mattison Surface Grinder. Its large capacity, ability to hog off stock and high power, keeps the 'time out' periods to a minimum.

A few examples of die jobs ground on the Mattison at a considerable saving in time, are shown on this page. Die shown in the lower left hand corner was ground with leader pins in place at 1/3 of former time. Wheel and spindle clearance of Mattison Grinder is sufficient to handle this type of work with ease, eliminating time required for disassembly and alignment when leader pins are removed.

For further data regarding use of Mattison Grinders for reconditioning dies, ask us to send you free set-up book on this subject.

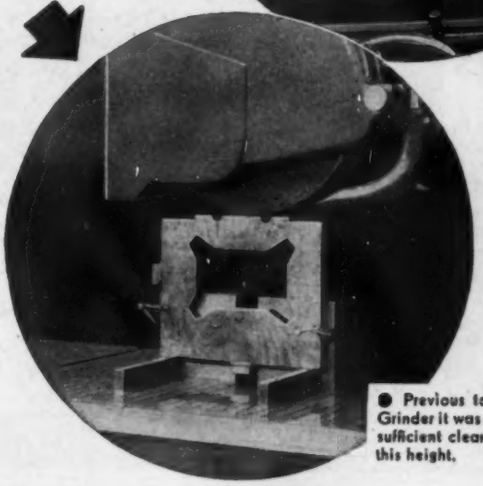


● Die is 20" x 24". Three-quarters of width is ground, then die is reversed on magnetic chuck and remainder of surface ground. Time 20 minutes.

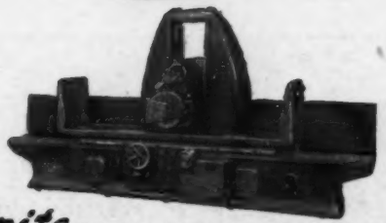


● Time is saved by grinding dies with leader pins in place.

● Material: Hardtem Steel Forging die.
Stock Removed: 1/64" from face side.
Present Time: 8 minutes.
Previous Time: 30 minutes.



● Previous to obtaining Mattison Grinder it was not possible to obtain sufficient clearance to grind dies of this height.



Write for Free Set-up Book containing further examples, showing how others have reduced time and cut costs with Mattison Grinders.

MATTISON MACHINE WORKS
ROCKFORD · ILLINOIS

Highest Production — Low Maintenance

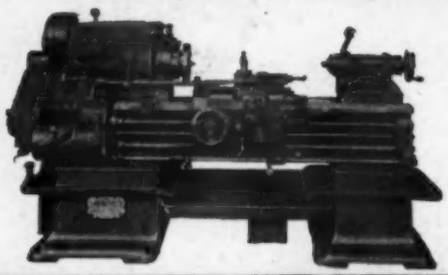
MILLING • DRILLING • REAMING • BORING • PIPE THREADING • SPECIAL MACHINES

DAVIS & THOMPSON COMPANY

MANUFACTURERS MACHINE TOOLS, MICROMETERS AND GAGES

MILWAUKEE WISCONSIN

SPRINGFIELD GEARED HEAD LATHES



. . . versatile, efficient!

Springfield designs lathes to retain accuracy and speed over long periods of use. For quantity production or special use they're economical and extremely adaptable. Sizes available range from 14" to 30". *Write for descriptive bulletins, prices and deliveries.*

The SPRINGFIELD MACHINE TOOL COMPANY • • • SPRINGFIELD, OHIO, U.S.A.

CARLTON RADIAL DRILL

FEATURES: 1. Low Hung Drive to Spindle. 2. All Power Driven Parts Running in Oil. 3. Quiet Running at all Speeds. 4. Concentrated and Convenient Push-button Controls. 5. Constructed on Unit Principle.

THE CARLTON MACHINE TOOL COMPANY

CINCINNATI 25, OHIO, U. S. A.

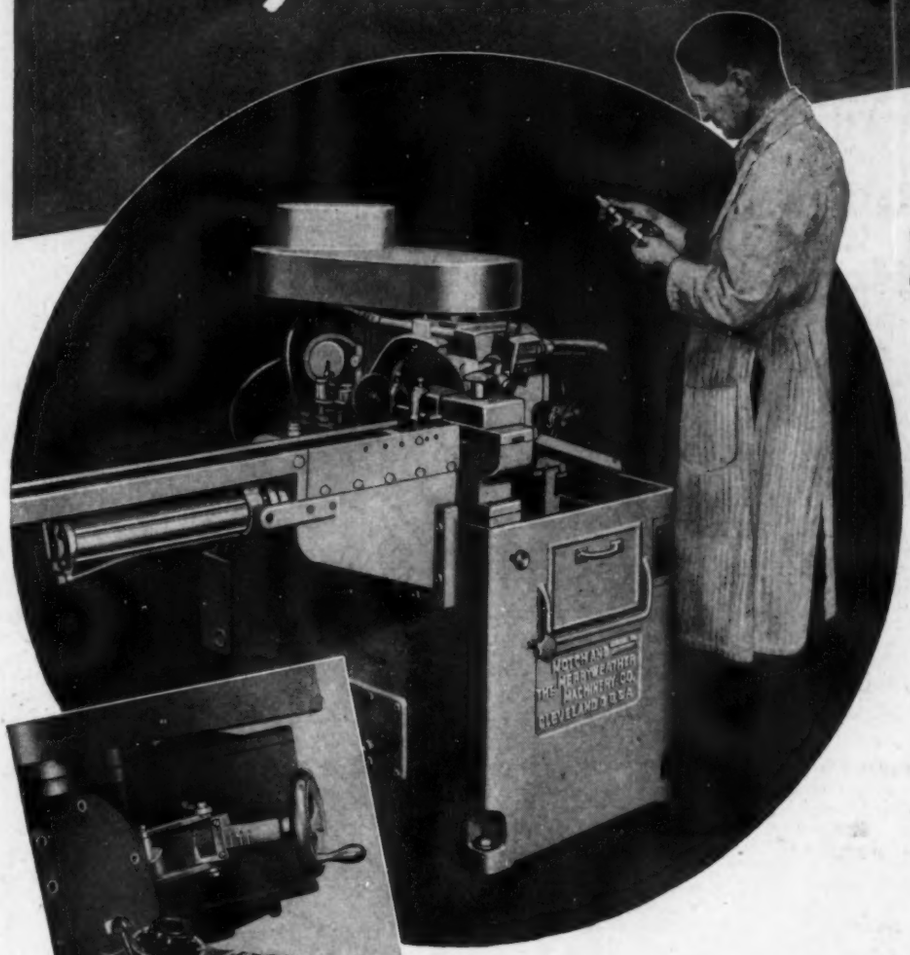
The Answers are Here . . .

in the Motch & Merryweather

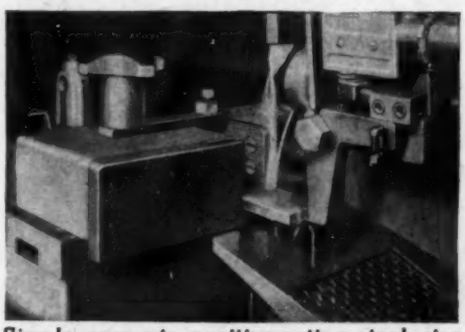
No. 00

CIRCULAR SAWING MACHINE

Triple-Chip METHOD



Feed control and cut-off time cycle easily adjusted.



Simple, accurate, positive-acting stock stop starts automatic clamping and sawing cycle.

All the proven fundamentals of Motch & Merryweather design and construction which insure smooth, clean, burr-less sawing and eliminate most second operations. Accurate, uniform lengths; high speeds; quick change from size to size and material to material for stock up to 2". Thorough-going Motch & Merryweather engineering has provided Triple-Chip blades to fit and a blade sharpener to grind them — an experience based on "building all 3". The answers within this range of work are here.

For more information write for our well illustrated Bulletin A-600.

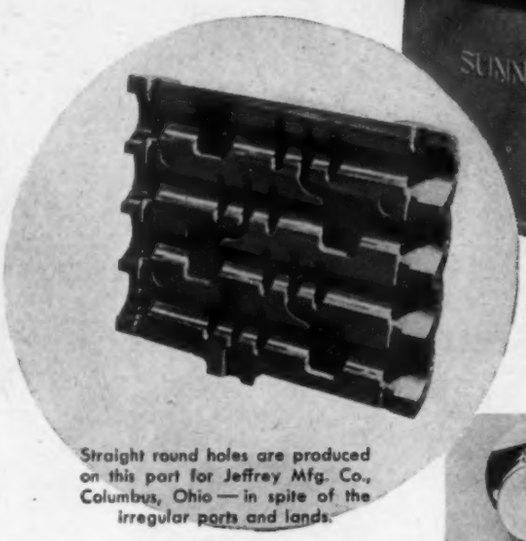
THE MOTCH & MERRYWEATHER MACHINERY CO.
PENTON BUILDING CLEVELAND 13, OHIO

SUNNEN PRECISION HONING

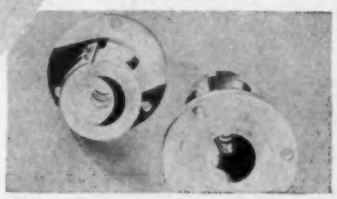
Finishes Internal Diameters on Valve Parts Quickly and Accurately-- Lengthens Life of Valves

These photographs show typical valves and valve parts on which Sunnen Precision Honing saves time, produces base metal finishes, and straight round holes free of bellmouth and taper. This means that a honed valve can be fit closer, will wear longer and seal better . . . right up to the edge of a port.

The Sunnen Precision Honing Machine is versatile — handles every internal diameter from .120" to 2.625" in any metal, plastic, glass or ceramic material, except lead and babbitt. New sizes are accommodated by small investment in new mandrels.



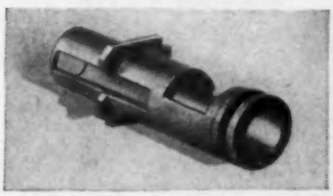
Straight round holes are produced on this part for Jeffrey Mfg. Co., Columbus, Ohio — in spite of the irregular ports and lands.



Gyroscope balance valve body "saves production time in getting closer limits of accuracy."

The sizing control on the Sunnen Precision Honing Machine permits removing as little as .0001", to produce a perfect fit. Maintains previously established alignment — duplicates sizes easily — requires no jigs or fixtures — can be set up ready to operate in one minute.

For additional information, write for bulletin XMAN-5000, or ask a Sunnen engineer to show you how Sunnen honing can be used in your plant.

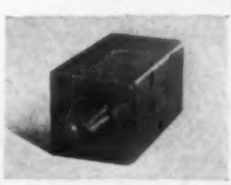


Removing .002" of stock from this bronze carburetor valve produces a straight round hole accurate within .0001".

SUNNEN
TRADE MARK REG. U. S. PAT. OFF. • MARCA REGISTRADA

SUNNEN PRODUCTS CO.
7941 Manchester Ave., St. Louis 17, Missouri
Canadian Factory: Chatham, Ontario

Bronze valve. The Sunnen Precision Hone is used to secure high finish and accuracy.



Saved time in producing a smooth accurate finish on this bronze remote control valve body.

Smooth accurate finish is produced on this bronze oil burner valve part with .001" to .002" stock removal.

A minimum of 70% bearing surface is produced on this hardened steel valve guide bushing. Reamer marks are removed—tolerance limits .0003".

223

SHIELD BRAND FIRSTS

FIRST IN QUALITY

Example, a pioneer in developing the use of high speed steel for drill construction. Today's Red Shield Drills are acknowledged tops.

FIRST IN ECONOMY

Example, first to say "Send us your tough jobs", thus inviting you to prove to yourself the service economy of Shield Brand Tools.

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Example, completely equipped metallurgical and testing laboratory controls quality at every step from raw material to finished product.

FIRST IN PERFORMANCE

Example, America's leading mass production industries—Automotive, Aviation, Electrical, Farm Implement, Home Appliance—all regularly specify, buy and use Shield Brand Tools.

FIRST IN UTILITY

Example, initiated the packaging of individual drills in strong cardboard tubes to give added protection and convenience in handling.

WE welcome the opportunity to work with you on difficult problems as well as regular production work. No obligation or cost. Shield Brand Drills, Reamers, Taps, Dies, Milling Cutters and Special Tools are furnished by Leading Mill Supply Distributors, coast to coast. For prompt service, call your Mill Supply Distributor.

STANDARD TOOL CO.

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CLEVELAND

Warehouses: New York · Detroit · Chicago

To save time and money in the production shop

Standardize on Standard Shield Brand Drills, Reamers, Taps, Dies, Milling Cutters and Special Tools

STANDARD TOOL CO.

IT SAVES TIME...

- In Purchasing
- In Stock Keeping
- In the Tool Crib
- In Production
- In Setting Up Work

BECAUSE

Standard Shield Brand Tools are all made in one factory—under one management to like standards of quality, uniformity and performance.

RESULT

Thus, one responsible source stands behind the performance of your metal cutting tools.

Uniform production at low cost is easier to attain with the interested cooperation thus secured—time is saved—profit margins are protected.

Leading Mill Supply Distributors from coast to coast supply these fine tools.

THE STANDARD TOOL CO.

CLEVELAND

Warehouses: New York · Detroit · Chicago

PRESS FORGING

ON THE PRODUCTION LINE BASIS

Photographs courtesy Reed Roller Bit Company, Houston, Texas.

THE dependable performance and high production of Ajax High Speed Forging Presses has led to their installation for turning out forgings on a production line basis. In conjunction with rotary or pusher type furnaces, the heated blank is carried by conveyor through a hydraulic descaler and delivered to the die space of the Ajax Press. The operator handles it through the several forging die impressions and passes it to a second conveyor at the rear, which delivers it to the trimming press operator. After trimming, what was a round-cornered-square blank less than a minute before, emerges as a finished forging. Ajax High Speed Forging Presses are built in nine sizes from 500 to 6000 tons capacities. All incorporate basic construction features which give them the dependable performance so essential to successful operation of a production line.

Write today for Bulletin 75-B.

THE AJAX MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND 1.7, OHIO

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DEWART BUILDING NEW LONDON, CONN.

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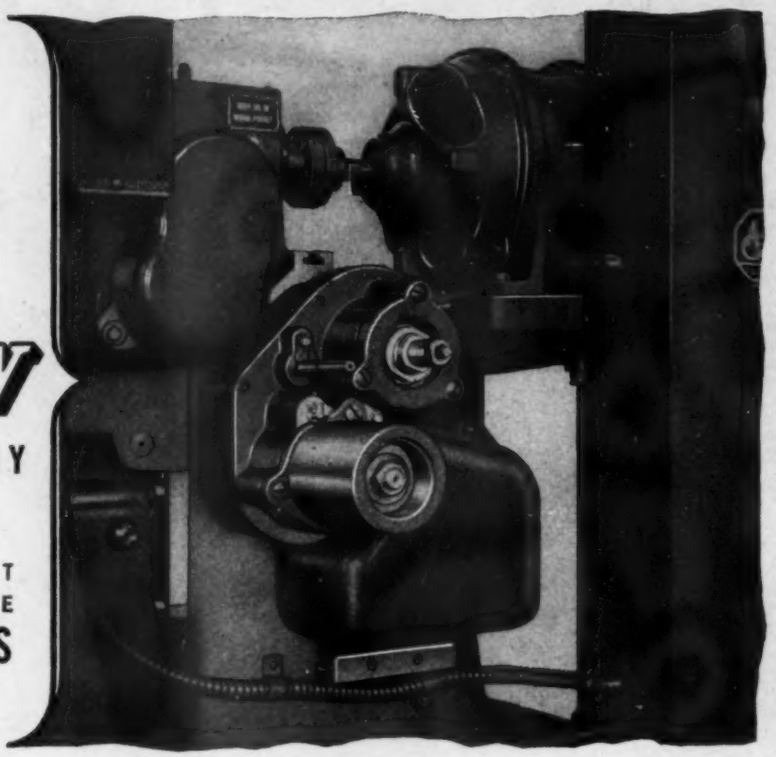
★

THE WORLD'S FINEST
MULTIPLE SPINDLE
CHUCKING MACHINES



Hammond of KALAMAZOO

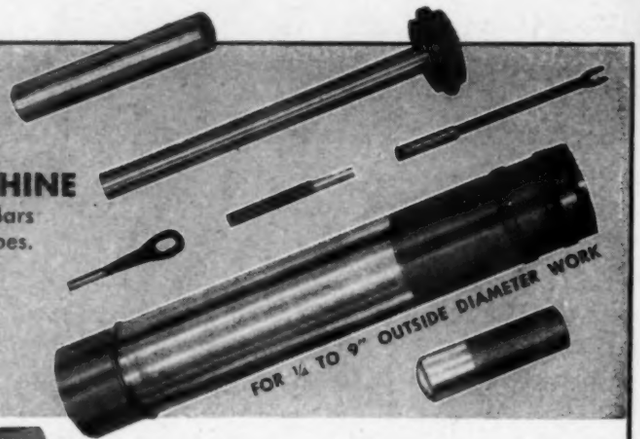
OD-9 CYLINDRICAL FINISHING MACHINE

For Faster, Better Finishing of Tubes, Rods, Bars and a Wide Variety of Cylindrical Shapes.

CENTERLESS No holding or chucking.

VERSATILE Uses abrasive belts or polishing and buffing wheels.

FAST UP to 30′ per minute.



For plunge cut or through feed. Idler roll fixtures as shown for long work. Send samples for detailed engineering report . . . no obligation.

See Hammond Equipment In Operation at Booths 65, 66, 67 and 68 at the Industrial Finishing Exposition, Detroit, June 23-27.

Hammond Machinery Builders INC.

1618 DOUGLAS AVENUE • KALAMAZOO 54, MICHIGAN

Look to MODERN for accurate, fast, economical thread cutting

Hardened and ground throughout

Wider threading range

Made with least number of parts

Cut close-to-shoulder threads without special chasers

Easily adjusted for thread size

Greater flexibility

Quick and easy chaser change

MODERN

STATIONARY TYPE SELF-OPENING

DIE HEADS

Modern Precision Tools Include . . . . .

- STATIONARY SELF-OPENING DIE HEADS
- ROTARY SELF-OPENING DIE HEADS
- STATIONARY COLLAPSIBLE TAPS
- ROTARY COLLAPSIBLE TAPS
- MODERN-MAGIC CHUCKS AND COLLETS
- SELF-OPENING STUD SETTERS
- INSERTED BLADE FACE MILLING CUTTERS
- SOLID ADJUSTABLE DIE HEADS
- ADJUSTABLE HOLLOW MILLING TOOLS
- UNIVERSAL CHASER GRINDING FIXTURES

Modern Self-Opening Die Heads thread diameters from ⅛" to 7" in standard heads, and up to 14" in special heads . . . accurately, fast, and economically. They are adapted to practically every thread cutting operation within their capacity. Designed for use in hand screw machines, turret lathes, and other machines where the die heads are used in a stationary position.

For complete information, write for Bulletin No. M-123

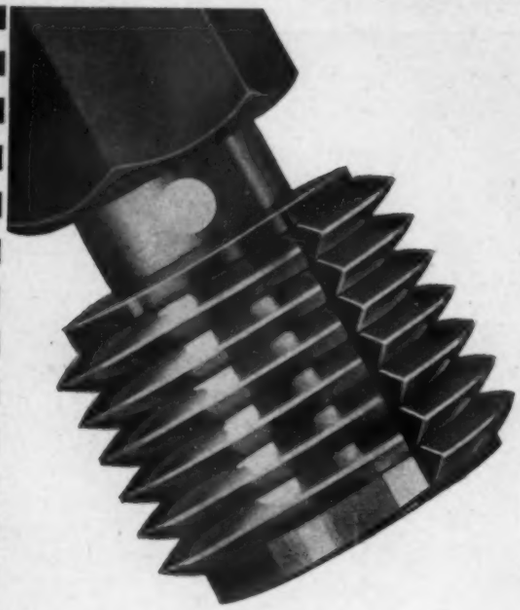
MODERN TOOL WORKS

DIVISION OF

CONSOLIDATED MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

That Unseen Extra Quality



"Convolution"

. . . is a process of grinding back the incomplete threads at the ends of the gage, so that the threads will start with a thread which has a full form profile.

The care given this detail in the manufacturing of Republic's thread plug and thread ring gages, eliminates thick end threads, allowing the customer the full working tolerance of the gage and permits the accurate setting of ring gages.

May we serve you?

RELY ON REPUBLIC

REPUBLIC GAGE

DETROIT 21, MICHIGAN

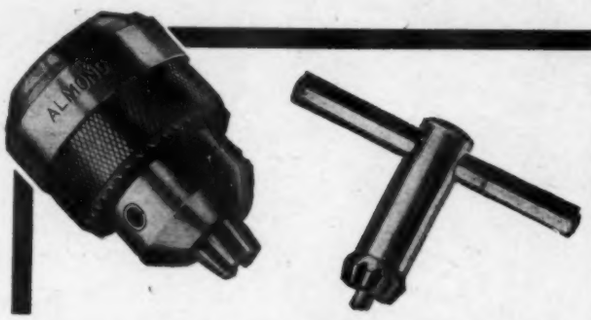
tops in the tool room

Save three ways with Grand Rapids No. 10-B Combination Tap and Drill Grinder:
1. Lower first cost; 2. Less maintenance expense;
3. Valuable floor space.

Write for Bulletin G.L. 8-46

Grand Rapids 10-B Combination Tap and Drill Grinder

GALLMEYER & LIVINGSTON COMPANY
Manufacturers of Grand Rapids Grinders
330 STRAIGHT ST., S. W., GRAND RAPIDS 4, MICH.



Almond Drill Chuck

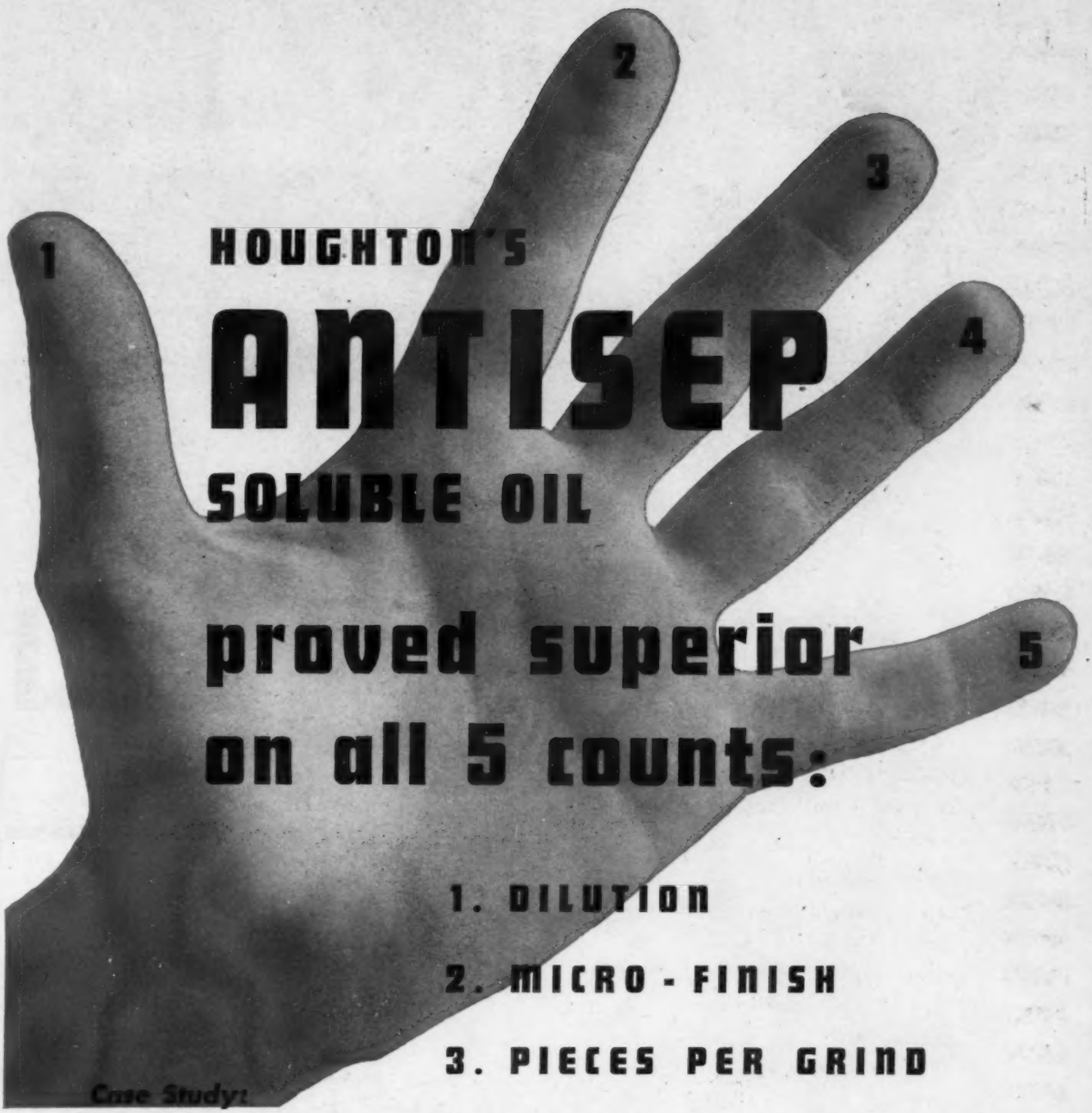
THE FIRST IN THE FIELD

ALMOND THREE-JAW DRILL CHUCKS were the first to be placed on the market over Seventy years ago. As Pioneers in the field of Drill Chucks, the name "ALMOND" has long been associated with the logical procedure of machine developments. ALMOND DRILL CHUCKS are made in types and sizes to fit all machine tools and portable drills.

Complete information is available on request.

The Original Manufacturers of Drill Chucks

T. R. ALMOND MFG. CO.
Ashburnham, Mass., U.S.A.



HOUGHTON'S ANTISEP SOLUBLE OIL

proved superior on all 5 counts:

1. DILUTION
2. MICRO-FINISH
3. PIECES PER GRIND
4. MACHINE CLEANLINESS
5. OPERATOR SATISFACTION

Case Study:

The operation: finish-grinding crank holes in connecting rods.

Results with Antisep, as compared to former coolant:

Dilution 80 to 1—formerly 40 to 1.

Finish 20-25 micro inches, formerly 30 to 40.

Pieces per grind: 275; formerly 200.

Machines much cleaner.

Operators happy with Antisep.

Test ANTISEP for yourself and learn firsthand why this revelation in water-soluble cutting oils is spreading from shop to shop. For details and prices, write E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia 33, Pa.

The Oil that's changing cutting fluid standards!

WHATEVER YOU DO . . .

WINTER ENGINEERS Can Help Solve Your TAPPING PROBLEMS

The services of WINTER Engineers are easily available to you for the solution of your tapping problems. Whatever type of work you do, wherever you may be, if you have a tough threading job, a call to your local WINTER distributor will quickly bring the assistance of all WINTER engineering facilities. These include carefully collected and classified case histories on almost every possible type of threaded work.

Leadership **BUILDS ON** *Craftsmanship*

Craftsmanship of the highest order always has been employed in the manufacture of WINTER Taps.

YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves —as close to your tapping problems as the telephone on your desk.

Winter Brothers COMPANY

WRENTHAM, MASS. and ROCHESTER, MICH. • **Distributors in Principal Cities**
A Division of the National Twist Drill and Tool Company • Branch Stores: San Francisco, Chicago, Detroit

FROM COAST TO COAST

There is a NATIONAL CUTTING TOOL Engineer To Serve You

NATIONAL Service Engineers are strategically located in every section of the country. Factory training and years of experience make them specialists in dealing with all types of problems concerning cutting tools and their uses. One of these engineers is nearby to serve you whenever you need him. His counsel and assistance are at your disposal without obligation. Just call the NATIONAL distributor in your locality.

Craftsmanship INSURES *Quality*

LEADING DISTRIBUTORS EVERYWHERE offer complete stocks of NATIONAL Cutting Tools. Call them for cutting tools or any other staple industrial product.

The skill and facilities to make NATIONAL Tools the best you can buy are supplied at NATIONAL'S great new plant in Rochester, Michigan.

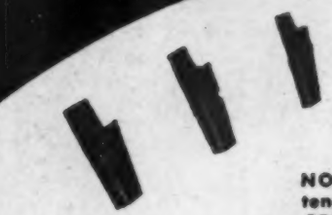
NATIONAL TWIST DRILL AND TOOL COMPANY

ROCHESTER, MICHIGAN, U. S. A. Tap and Die Division — Winter Bros. Co.

Distributors in Principal Cities • Factory Branches: New York • Chicago • Detroit • Cleveland • San Francisco

. . . A "REVOLUTION" IN MACHINING INDUSTRY . . .

TOUGH Threading jobs licked by COULTER TYPE "H" THREAD TAP MILLING MACHINE

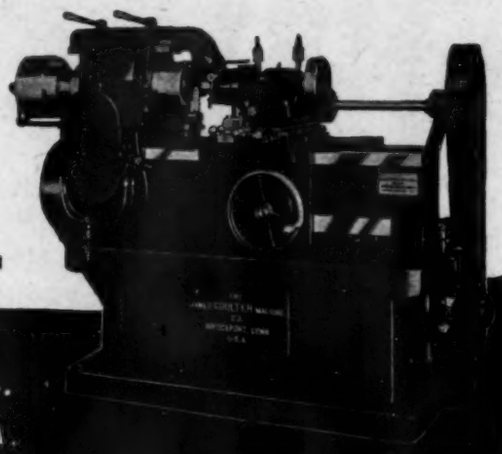


NOW . . . comes a development that extends the capacity of this 'wonder' machine. COULTERS' are made to perform the most delicate threading operation with both speed and accuracy . . . 40 years of specialized experience, manufacturing precision machines exclusively. The NEW Type "H" is equipped with *an overarm tail center and large collet chuck*, holding the work rigidly so *ONLY ONE REVOLUTION OF THE TAP* is necessary.

Any number of FLUTES, eccentric or concentric relief straight or taper can be produced. Pipe taps from ⅛" to 1½" and straight taps from ¼" to 1½"

WRITE FOR FULL PARTICULARS

PRODUCTION MACHINES SINCE 1896



TYPE H

The James **COULTER** *Machine Co.*

BRIDGEPORT • CONNECTICUT • U.S.A.

Hammond

of KALAMAZOO

CARBIDE GRINDERS

A MODEL FOR EVERY NEED

MODEL W-10

MODEL CB-77

HAMMOND CARBIDE TOOL GRINDERS are made for wet, dry or wet-or-dry grinding with wheels from 6" to 14" diameter.

CHIP BREAKER and diamond finishing grinder. Heavy duty. For fast, smooth precision tool grinding.

WRITE FOR BULLETIN

Hammond Machinery Builders

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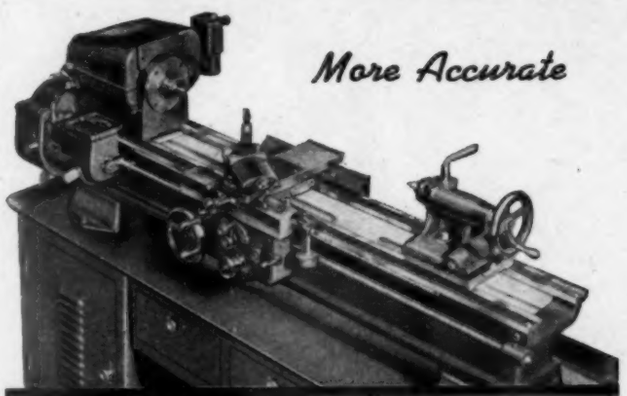
More Accurate



New SHELDON

TRB-S56 Precision Lathe

There is a degree of accuracy built into the new $1000.00 Sheldon TRB-S56 Precision Lathe heretofore found only in a few of even the most costly lathes. For example, spindle bearings are "Zero Precision," the very finest, closest tolerance tapered roller bearing manufactured. The heavily strutted, 1-piece bed has 2 V-ways and 2-flat ways ground on special bed grinder and held to the closest tolerance of lateral and parallel alignment.

In the Sheldon TRB-S56 modern engineering, extensive tooling combined with the finest special machinery—a modern machine tool plant with modern equipment, modern manufacturing methods—give this small (11¼" swing, 1" collet capacity, 56" bed, 8 speed—50 to 1350 r.p.m.), convenient, moderate priced lathe, the permanent accuracy and features, heretofore found only in more cumbersome and costly lathes.

Write for Circular

SHELDON MACHINE CO. Inc.

4234 NO. KNOX AVENUE, CHICAGO 41, ILL., U.S.A.

Now is the time to take advantage of OAKITE'S COST-CUTTING materials and methods for Cleaning and Surface Conditioning

ALUMINUM SURFACES for PERFECT PAINT ADHESION!

BEFORE applying baked enamel, paint or other organic finishes to aluminum, careful conditioning of surfaces goes far toward obtaining a high-grade sales-appealing protective finish.

So, if you are engaged in the production of aluminum coaches, radios, outboard motors and the like, we suggest you investigate the widely-used, low-cost method of preparing surfaces with

Oakite Compound No. 36

A mildly acidic liquid, this scientifically designed Oakite surface conditioner, used manually or in still tank, gives surfaces a microscopic etch, then develops a thin adherent phosphate film. This film provides an ideal adsorptive base for good initial adhesion and permanent paint grippage.

Localizes Corrosion

Phosphate film also acts as an excellent corrosion-retardant . . . localizes oxidation caused by scratch and prevents spreading of peeled paint around those damaged areas.

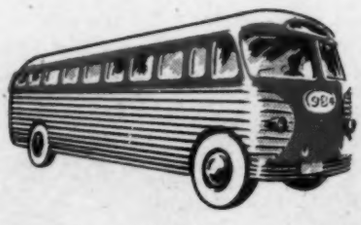
Cuts Cleaning Time

Oakite Compound No 36 has light detergent properties . . . saves degreasing time and cost in those instances where parts are not too heavily soiled.

FREE In-Shop Service

A nearby Oakite Technical Service Representative will be glad to put Oakite Compound No. 36 through its paces in your plant, under your own conditions. There may be a chance that he can cut some corners for you. Call Oakite today!

OAKITE PRODUCTS, INC., 18 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in Principal Cities of U. S. & Canada



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REG. U. S. PAT. OFF.

Specialized Industrial Cleaning
MATERIALS · METHODS · SERVICE

for Sawing METAL *as* HARD *as a* FILE
or Trimming FORMED PARTS
- FAST!

Actual photo of file friction sawn on Tannewitz High Speed Band Saw

Tannewitz
HIGH SPEED BAND SAWS

Cost reductions that are downright amazing are effected in the cutting of an extremely wide variety of materials by friction sawing with TANNEWITZ HIGH SPEED BAND SAWS: flat sheets, hardened or soft steels, armor plate plastics, and many others. Formed aluminum parts can be trimmed without using a rest of any kind. Whatever your cutting problem, chances are it can be done faster and better with TANNEWITZ HIGH SPEED BAND SAWS. Write for booklet: "FRICTION SAWING."

THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

These are the
NEW
DUBLIFE Plug Gages with
COLORED *Plastic* (INSULATING) COLLETS

GREEN for "GO"

REVERSIBLE

RED for "NO GO"

Colored Collets identify plug instantly. Weight is reduced, Plugs securely locked without marring or scratching plugs as with metal collets.

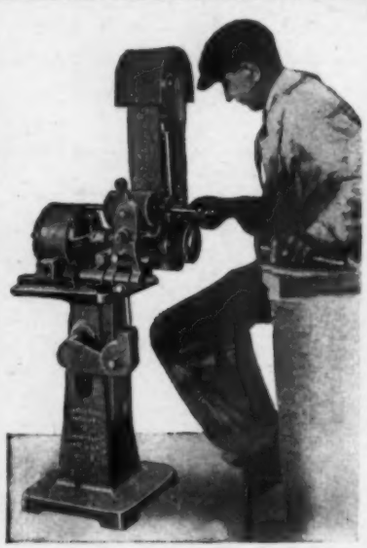
New Light Weight Handle with these collets.

DUBLIFE

In one and same balanced handle, 2 "GO" and 2 "NO GO" Plugs. Tolerances to .00002. Reverse either plug when wear shows and you have a new, fresh gage. Time saving! Gage saving! Money saving! It is to your advantage to know about DUBLIFE GAGES with colored plastic collets and light weight handles. Send for complete catalog showing DUBLIFE and A. G. Design Gages.

Ask for Catalog "G"

UNITED PRECISION PRODUCTS CO.
SHABBONA, ILLINOIS



"PRODUCTION"
Type "S"
Speeds finishing of cylindrical or flat work

This machine can be used for straight line finishing of flat work by hand manipulation. The flat surfacing bed is quickly removable, leaving the abrasive belt flexible for finishing irregular shapes. Even in the hands of inexperienced operators, the Type "S" machine assures a high speed, fine, uniform finish. It will handle cylindrical work up from ¼" to 1" diameter automatically by means of Centerless Feed Attachment, no centering or chucking being required.

Write for illustrated literature

Specifications

Abrasive belt—4" wide, 60" long
Motor 1 H.P., 1750 RPH
Belt speed—3200' per min.
Dist. table to floor (Horizontal position) 36"
Table—4½"x13½"
Ball Bearing equipped

Production
MACHINE COMPANY GREENFIELD, MASSACHUSETTS, U.S.A.

DAVIS KEYSEATER

This low cost machine will handle internal keyseating jobs up to 1¼ in.

Write for illustrated bulletin.

DAVIS KEYSEATER CO., 403 Exchange St., Rochester, N. Y.

Famous for
- ACCURACY OF THREADS
- LOW CHASER COST
- ALL AROUND DEPENDABILITY

Bulletins available: General Purpose Die Heads, Insert Chaser Die Head, Threading Machines.

See our Advt on page 310 May 8th American Machinist

THE EASTERN MACHINE SCREW CORP., 20-40 Barclay St., New Haven, Conn.
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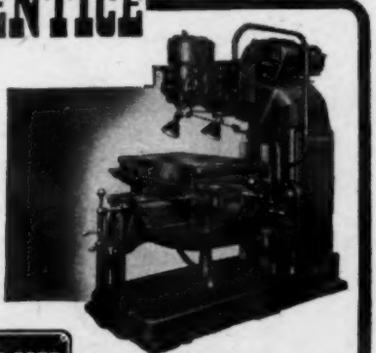
LATHES
DIE CASTERS
DIE SINKERS
VERTICAL MILLERS
INJECTION MOLDERS



REED-PRENTICE CORP.

Now, **YOU CAN PICK THESE SEALED PACKAGE**

POPE PRECISION GRINDING SPINDLES

Right off the shelf!

1.

POPE Sealed Motorized 6" x 18" Surface Grinder Spindle with sealed-in 1 HP motor and *sealed lubrication* SKF super-precision, double row, roller bearings. Produces finer finishes. Roughs off surplus metal fast. Write for *Data Sheet No. 12.*

2.

POPE Motorized Spindle for Surface Grinders and Boring Mills with sealed lubrication and 3, 5 or 10 HP motor running at 1200, 1800 or 3600 RPM. Produces better final finishes. Increases production. Runs in any position. Write for Data Sheets 16, 17, 18, 19.

3.

POPE Wheel Head with sealed lubrication, for special grinding, boring and other operations requiring from 3 to 25 HP. May be mounted horizontally or at any angle. Designed to operate at whatever speeds meet your requirements. Write for recommendations and quotations.

4.

POPE Tool and Cutter Grinder Spindle with sealed lubrication. Operated by single Vee belt drive at speeds up to 6000 RPM. Fits standard grinders. Write for recommendations and quotations.

5.

POPE Internal Grinding Spindle with sealed lubrication. Comes in a wide range of sizes and speeds up to 35,000 RPM. Produces more accurate hole sizes and better finishes. Write for Catalog No. 56.

6.

POPE Double-Ended Tool and Cutter Grinder Spindle with sealed lubrication. Belt drive, with twin pulleys for two speeds from step pulley on motor. Speeds up to 6000 RPM. Fits standard grinders. Write for recommendations and quotations.

No. 44

POPE

POPE MACHINERY CORPORATION

ESTABLISHED 1920

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BUILDERS OF PRECISION SPINDLES

ROCKWELL Hardness ALONE is not enough for MILFORD*

REZISTOR HACK SAW BLADES

It's Laboratory Control of Heat Treatment that Maintains the Fine Cutting Edges.

The structure of the teeth . . . the "business end" of MILFORD blades . . . is controlled during every-day heat treating operations by continuous micro-photographic examination.

Sample heat-treated blades are taken from each furnace, teeth are mounted in plastic molds, and examined at 500 diameters. If the tooth structure is not just right, furnace adjustments are made and further sampling required. Even after the Metallurgical Department gives the "go-ahead," additional samples are examined during the day.

A MILFORD hardened tooth shows the "white area" of a properly hardened structure at the cutting edge, assuring maximum cutting performance. The heavier solid body below is tough for maximum strength.

Just Another Reason Why Milford Rezistor Blades Are the Finest Hack Saw Blades that Money Can Buy!

*Trade Mark Reg. U. S. Pat. Off.

Order from your Mill Supply Distributor. He is always ready to serve your needs for all factory and mill supplies as well as MILFORD hack saw and band saw blades.

MILFORD PROFILE AND BAND SAW BLADES REZISTOR AND DUPLEX HACK SAW BLADES

THE HENRY G. THOMPSON & SON CO.

Saw Specialists Exclusively for Over 65 Years

NEW HAVEN 5, CONNECTICUT, U. S. A.

The Lyon INTERNAL GROOVING TOOL

Its versatility saves costly preparation time—provides precision grooving of single or multiple grooves at a production rate—plus economy of set-up time—and low initial cost. The LYON has been designed for making internal grooves to tolerances of .001" using any drill press, turret lathe, radial drill or automatic equipment.

By changing only bushings and cutters within the tool model range, you have at your command a wide variety of bore sizes and shapes. A simple adjustment regulates location and depth of groove. Work cannot be scratched or marred because the head of the tool does not turn when the cutter operates.

Our Engineering Department will welcome the opportunity of discussing any grooving problem without obligation.

LYON MACHINE CO., WORCESTER 3, MASS.

Slash Machining Costs!

Use *Improved* TECO Cemented Carbide

for
- more pieces between grinds
- more grinds per tool
- less down time
- lower tool cost

ANOTHER TYPICAL CASE

Part machined: Piston Rings
Machine: Porter Cable Lathes
Material: Fine grain cast iron
Operation: Turning
Depth of cut: .025"
Feed: .015"
Speed: 200 rpm.
PIECES PER GRIND: 10,000–12,000 (production runs)
Best previous record: 2,500 pieces per grind
Note: Same grade TECO used for both roughing and finishing

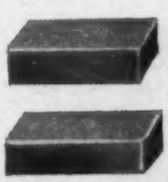
WHEREVER you now use carbide in your shop—you've got an opportunity to make big savings, by switching to Improved TECO Cemented Carbide. Users report production increases of 3 to 10 times over former carbides used. We may be able to help you, too. It's worth investigating.

Why not make this simple comparison? Equip a machine with Improved TECO, on any carbide job. Run exactly as before. Check it against your former production figures, for pieces per grind—grinds per tool—total pieces per tool—tool cost. Then, step up speeds and feeds and note its unusual performance.

Why not arrange to demonstrate to your own satisfaction the superior performance of Improved TECO? Our tool engineers are glad to discuss your needs. If you prefer, send details of your machining problems for recommendation. Ask for latest catalog and price list.

Improved
TECO
CEMENTED CARBIDE

TECO TOOLS and BLANKS
for prompt shipment
Wide range of sizes and styles for most machining needs.



TUNGSTEN ELECTRIC CORPORATION
568 39th STREET, UNION CITY, N. J.
Branch Office: 403 Western Reserve Bldg., Cleveland 13, Ohio
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LEAD HAMMERS!

YOU MAKE 'EM!

3 AT ONCE!

WITH THE *New* COOK PRODUCTION HAMMER MOLD!

EASY to use! Close lid of mold . . . pour lead from lead pot or ladle into 3-in-1 mold . . . that's *all!*

SHUR-GRIP HANDLES — The Cook 3-in-1 Hammer Mold is made expressly for extra safe COOK SHUR-GRIP handles!

A Complete Lead Hammer Service

Handles (Shur-Grip) Mold and Ladles (single and 3-in-1 molds) Ready-Made Lead Hammers (in stock from 1 to 11 lbs.)

Ask for complete price list H.
Address Dept. 3

LAWRENCE H. COOK, INC.
Successors to the Johnson Tool Company
PLASTIC MOLDS AND TOOLS
65 Massasoit Ave., East Providence 14, Rhode Island

CECO-DROP
is
easy on the
operator
•• hammermen prefer
the safer-easier-operated
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CHAMBERSBURG IMPACT
1897 • Fiftieth Anniversary • 1947

CHAMBERSBURG ENGINEERING CO. • CHAMBERSBURG, PA.

MOREY
UNIVERSAL TURRET LATHES

Designed to take full advantage
of Carbide Tools
1", 1½", 2" capacity

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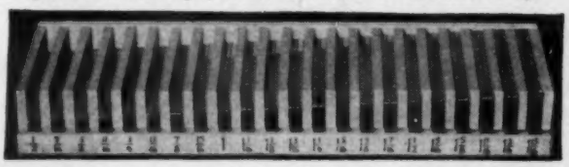
ANTON PARALLELS

INCREASE PRODUCTION IMPROVE QUALITY USE ANTON PARALLELS ANTON PARALLELS FILL A LONG-FELT NEED—Permanently straight and accurate, yet priced for general machine shop use. All fully guaranteed to be within the limits specified. Maximum size tolerance .001 inch on ground sides. Maximum variation in parallelism and straightness within length, .0001. Rockwell "C" hardness 65 up.



Price per set includes a handy Wooden Container. Large Stock of Single Pairs also Available. All Prices are F.O.B. New York

ANTON MACHINE WORKS
52 Sands St. Tel. TR. 5-8092 Brooklyn 1, N. Y.

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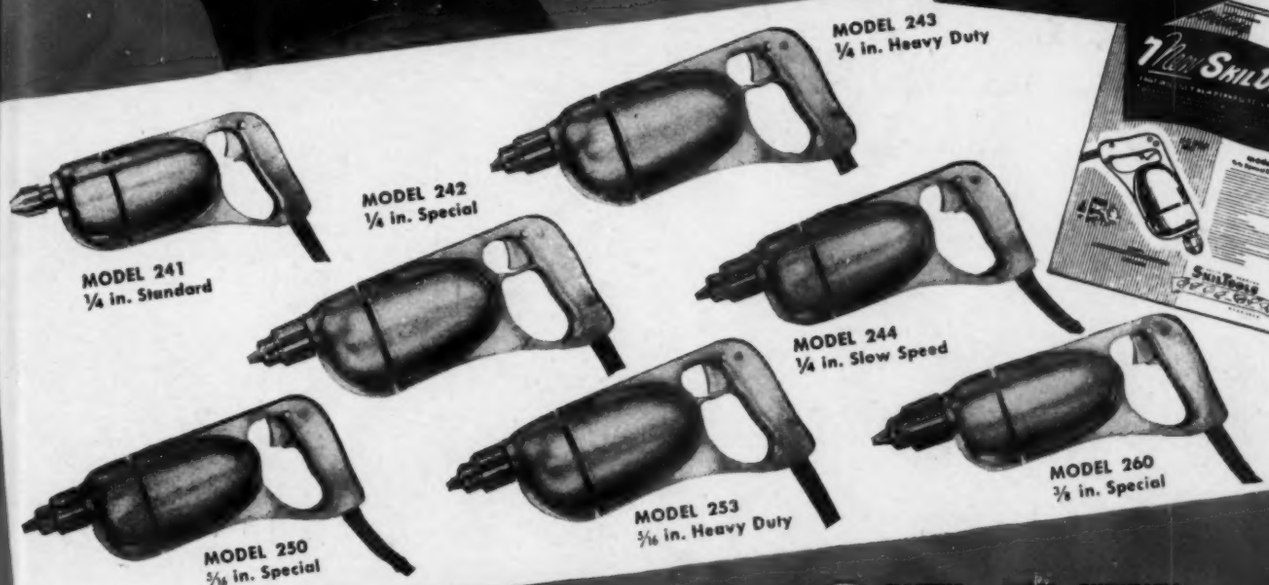
7 NEW SKILDRILLS . . .

7 NEW GOOD REASONS TO

SKILDRILL IT!

● The new SKILDRILLS you've wanted and waited for are here. They're new in design and engineering . . . in lightness and compactness . . . in drilling speed and power. New SKILDRILLS will bring you better, faster, easier drilling and longer service on every job. Ask your distributor about a demonstration TODAY!

SEND FOR FREE FOLDER



ELECTRIC PNEUMATIC

SKILTOOLS

SKILSAW, INC. 5033 Elston Ave., Chicago 30, Ill.

Factory Branches in Principal Cities

MADE BY SKILSAW, INC.

HERE'S SCRAP METAL BALING AT *Top Production*

The Dempster-Balester, Model 275, is setting production records everywhere because it's built to deliver the high speed service that top production demands. On the Dempster-Balester, all points of strain are built oversize to withstand internal stresses beyond the normal needs of baling. The charging box is carefully squared and completely lined with 3/4" abrasion plates from which all roughness and high spots have been machined off. This rugged, dependable machine delivers uniform, high density 275 pound bales that are easily handled from baler to furnaces. For complete information and illustrated literature write or wire today.

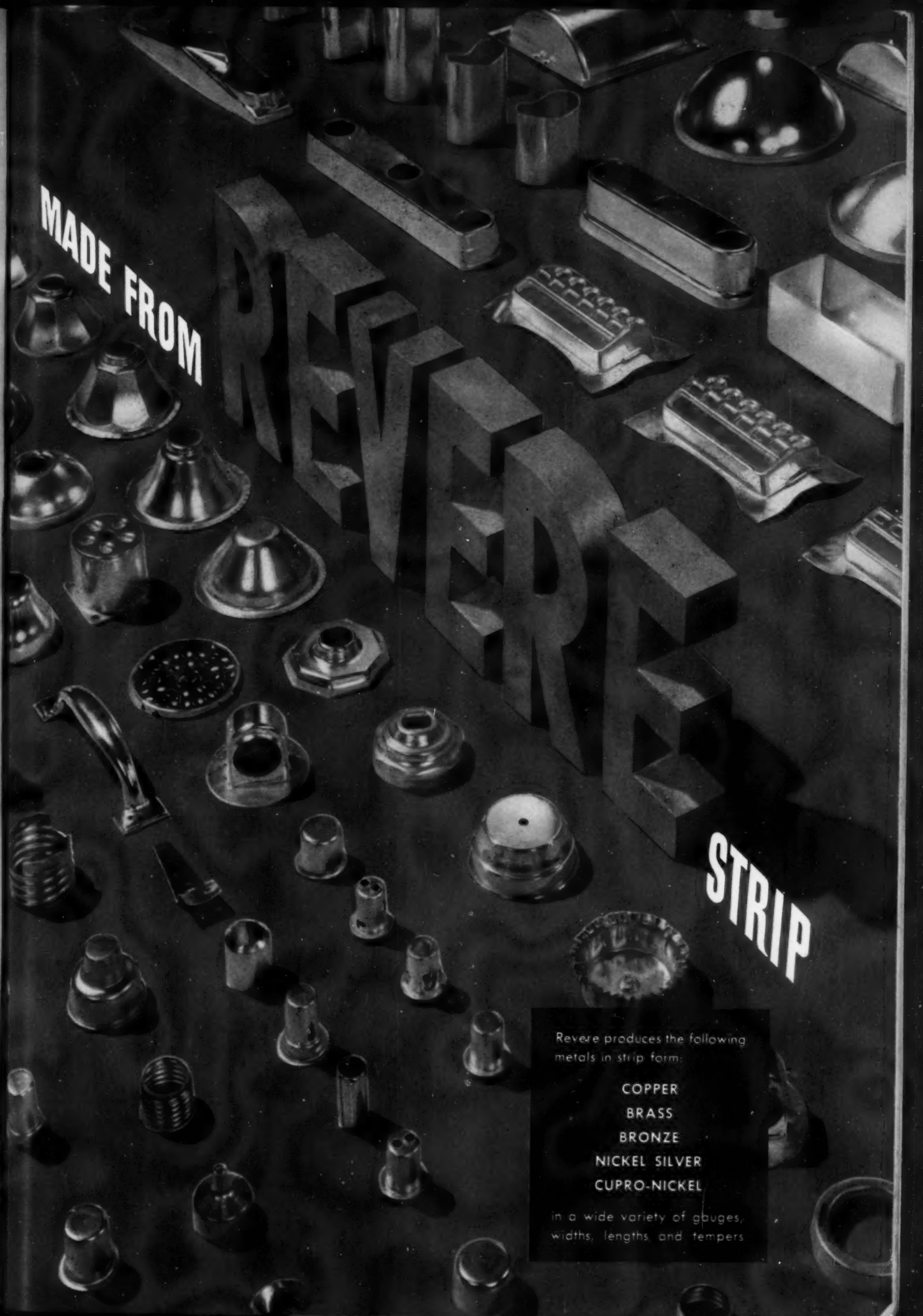
DEMPSTER BALESTER

TRADE MARK REG.

Photographs show a Dempster-Balester Model 275, with loading pan, set in a pit for ground level loading. Above, top: Scrap being dumped in charging box by loading pan.

Above: View of hydraulically operated loading pan in dumping position. Left: Finished bale held in place by ejector while charging box door comes forward to push it off of the press. Bales are forced onto roller conveyor, then power conveyor hoists them into railroad cars.

DEMPSTER BROTHERS, INC. **267 HIGGINS, KNOXVILLE, TENN.**


MADE FROM
REVERE
STRIP
Revere produces the following metals in strip form:
COPPER
BRASS
BRONZE
NICKEL SILVER
CUPRO-NICKEL
in a wide variety of gauges, widths, lengths and tempers

REVERE

STRIPS and ROLLS for fast, economical fabrication

Revere Metals in strip and roll form are widely used through industry for the manufacture of parts and products by such processes as deep drawing, stamping, punching, spinning, embossing, rolling, etching, soldering, polishing, plating.

Special finishes, such as embossed, polished, etc., are available for some alloys and forms. Naturally, the value of such finishes depends upon two main factors: the fabrication processes through which the metal is put in your plant, and the nature of the articles or parts you make. Where suitable, special finishes often reduce costs and improve the beauty, attractiveness or service of the finished product.

BRASS

Probably most manufacturers when they think of non-ferrous strip think of brass, because it is an old and honored metal, corrosion-resistant, and adaptable to a wide range of fabrication conditions, from simple stamping to exceptionally deep drawing, as in cartridge cases. Yet it should be remembered that *brass is not just brass.* There are many different brasses which vary in their composition. In addition, each brass alloy can be had in a variety of physical conditions. By rigid control of processing in the Revere Mills, strict specifications as to temper, hardness, and grain size are met.

COPPER — BRONZE NICKEL SILVER — CUPRO-NICKEL

But in addition to brass strip, Revere also produces strip in copper, bronze, nickel silver, and cupro-nickel. As is the case with brass, each of these is available in a range of compositions and physical characteristics.

GENERAL CONSIDERATIONS

The importance of a careful study of both composition and physical properties cannot be stressed too often, particularly at this time, when certain war developments in the metal industry should be taken into account. It might be, for example, that a difference in alloy, temper, gauge or dimensions would make manufacturing economies possible by increasing the number of draws between anneals.

Worthy of consideration when specifying strip is the question of gauge and width. It is sometimes the case that a reduction in the cost of the material can be achieved by slight changes in gauge and width. To this saving may be added an additional one—reduction in amount of scrap. Though scrap from strip has a high re-sale value, it costs money to segregate and bale it, and any reduction in its amount represents a saving.

Strip is an exceptionally useful form of metal. Revere will gladly cooperate with you in studying the important subject of specification.

On this page you will find technical data on only a few of the Revere Metals produced in strip and other forms as well. If you require further information, get in touch with any Revere Office or distributor.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

COMMERCIAL BRONZE, 90%

Alloy no. 120 • (copper 90.0%, zinc 10.0%)

Forms available: sheet, strip, plate, rod, tube, forgings.

General Properties: Revere Commercial Bronze, 90%, has high ductility. Compared to copper, it has higher tensile strength but lower thermal properties.

Typical uses: Commercial Bronze, 90%, is used for costume jewelry, compacts and lipstick cases. Also recommended for forgings, screws, weather stripping and standard hardware.

Working Properties: Cold-working, soldering, polishing — excellent. Hot-working — excellent. Machining—poor. Welding—gas, carbon arc, metal arc.

ASTM specifications: Sheet: B36, B130. Rod: B134

RED-BRASS, 85%

(Rich Low Brass) • Alloy no. 130 • (copper 85.0%, zinc 15.0%)

Forms available: sheet, strip, plate, rod, wire, tube, pipe and lockseam tubing.

General Properties: Revere Red-Brass, 85%, has higher strength and greater ductility than copper, and its excellent corrosion resistance often exceeds that of copper, as in salt water.

Typical uses: Red-Brass, 85%, is recommended for jewelry, name plates, badges, tags, dials, hardware, etched parts. For tubing and pipe for oil and utility fields and plumbing. Also for automobile radiators, bellows and flexible tubing.

Working Properties: Cold-working, soldering, polishing — excellent. Hot-working — good. Machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B36, B111, B135. Rod: B134. Tube: B43.

SEVENTY-THIRTY BRASS

(Cartridge Brass) • Alloy no. 160 • (copper 70.0%, zinc 30.0%)

Forms available: sheet, strip, tube, rod, rectangular bar and lockseam tubing.

General Properties: Revere Seventy-Thirty Brass has the best combination of ductility and strength of all the brasses and accordingly has superior cold-working properties.

Typical uses: Seventy-Thirty Brass is recommended for cartridge cases, ammunition components and for any difficult deep drawing, stamping or spinning job.

Working Properties: Cold-working, soldering, polishing — excellent. Hot-working — good. Machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B19, B36. Tube: B135. Rod: B134.

YELLOW BRASS

Alloy no. 170 • (copper 66.0%, zinc 34.0%)

Forms available: sheet, strip, rod, wire, and lockseam tubing.

General Properties: Revere Yellow Brass possesses excellent cold-working properties with good corrosion resistance. Mechanical properties and corrosion resistance are similar to those of alloys no. 160 and no. 165.

Typical uses: Yellow Brass is recommended for pins, rivets, eyelets, auto radiator cores, heating units, lamp bodies and reflectors, electrical sockets, and drawn shapes. Also for deep drawing, stamping, spinning, etching and rolling for practically all fabricating processes.

Working Properties: Cold-working, soldering, polishing—excellent. Machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B36.

PHOSPHOR BRONZE, 5% (A)

Alloy no. 308 • (copper 95.0%, phosphorus 0.05%, tin 5.0%)

Forms available: sheet, strip, rod.

General Properties: Revere Phosphor Bronze, grade A, possesses high tensile strength, high resistance to corrosion and fatigue and has a low friction coefficient. It is also highly resistant to season cracking.

Typical uses: Revere Phosphor Bronze, grade A, is used for springs, diaphragms, bellows, lock washers, cotter pins, fuse clips, clutch discs, screw machine stock, perforated sheets, etc.

Working Properties: Cold-working, soldering, polishing — excellent. Hot-working — poor. Machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B100, B103. Rod: B139.

NICKEL SILVER, 18% (A)

Alloy no. 533 • (copper 65.5%, nickel 18.0%, zinc 16.5%)

Forms available: sheet, strip, lockseam tubing.

General Properties: Revere Nickel Silver has high resistance to corrosion and tarnish. It is also malleable and ductile.

Typical uses: Nickel Silver is recommended for marine and automotive trim, hardware, architectural panels and extruded shapes, lighting, electrical and plumbing fixtures, various equipment of the process industries, tableware, jewelry, stamping and etching.

Working Properties: Cold-working, soldering, polishing—excellent. Hot-working, machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B122. Rod: B151.

NICKEL SILVER, 18% (B)

Alloy no. 555 • (copper 55.0%, nickel 18.0%, zinc 27.0%)

Forms available: strip, lockseam tubing.

General Properties: Revere Nickel Silver (spring stock) possesses high physical properties, high resistance to corrosion and tarnish and high fatigue strength.

Typical uses: Nickel Silver (spring stock) is recommended especially for springs, also for marine and automotive trim, hardware, architectural panels and extruded shapes, lighting, electrical and plumbing fixtures, various equipment of the process industries, tableware, jewelry, stamping and etching.

Working Properties: Cold-working, soldering, polishing—excellent. Hot-working, machining—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for thin gauge.

ASTM specifications: Sheet: B122.

HERCULOY

(Silicon Bronze)

Alloy	Copper	Silicon	Manganese
420	96.0%	3.0%	1.0%
421	98.00%	1.75%	0.25%

Forms available: sheet, strip, plate, rod, wire, tube, forgings.

General Properties: Herculoy has excellent mechanical properties. The strength of Herculoy is comparable to that of low and medium carbon steel. Its resistance to corrosion is similar to that of copper. These alloys are non-magnetic and gold colored.

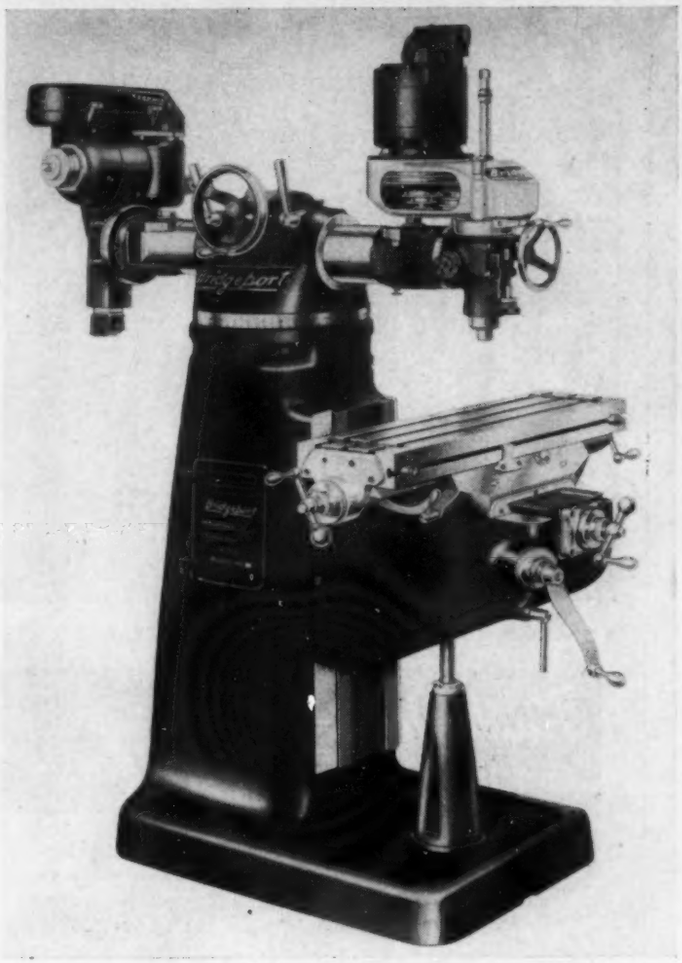
Typical uses: Herculoy is recommended for tanks, pressure vessels (unfired pressure vessels codes), vats, baskets, hardware, bolts, screws, lag screws, cotter pins, washers, turnbuckles, marine construction, shafting, plates, screens, filters, ducts, weatherstrips, springs, forgings, electrical conduit.

Working Properties: Cold-working, soldering—excellent. Hot-working—good. Machining, polishing—fair. Welding—gas, carbon arc, metal arc, spot and seam welding for narrow gauge.

ASTM specifications: Sheet: B96, B97, B100. Rod: B98, B124.

Nothing pleases Revere more than to be able to sit down with a customer and discuss fabrication methods and end uses. Such friendly collaboration often has resulted in increased production, lower costs, an improved product, or all three. In one case, substitution of leaded brass for high brass was suggested, for greater ease in blanking and to reduce the need for dressing down with a file after assembly. In another, a slight change in gauge reduced material cost. In still another, a different temper eliminated one anneal. The Revere Technical Advisory Service is at your command.

Bridgeport



TURRET MILLING MACHINE

ONE "Bridgeport"
for jobs often requiring
SEVERAL MACHINES

Specially designed to handle drilling, milling, boring or shaping at all angles of the work with one set up, the "BRIDGEPORT" saves the cost of several single purpose machines. Furthermore it conserves production time and eliminates the chances of error where work must be set up each time for an individual operation.

The capacity of the "BRIDGEPORT" for handling small or medium size work plus its speed, accuracy and convenience make it a valuable asset in any shop faced with the problem of bringing production costs down to a competitive basis.

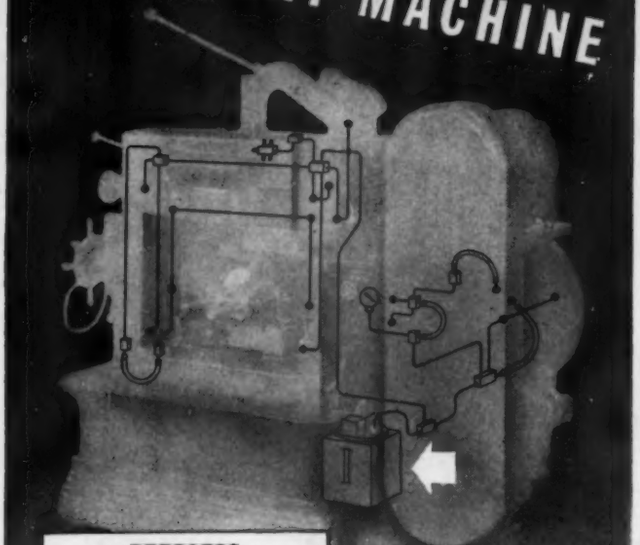
Write for further details.

Specifications

Longitudinal Feed—20" with standard tools
Cross Feed—9"
Vertical Feed of Knee—16"
Standard Table—9" x 32"
Special Tables 36", 42" and 48" available; also longitudinal power feed.
Weight with Shaping Unit—2000 lbs.

Bridgeport MACHINES, INC.
Bridgeport, Connecticut

A BIJUR SYSTEM FOR EVERY MACHINE



PEERLESS
"Mechani-Cut" Saw
Automatic Lubrication by
BIJUR

how it works

Driven by the machine, a lubricator (arrow) discharges 60 drops of filtered oil every 4 minutes . . . oil is instantly force-fed thru a line of branched tubing to 22 heavy-duty ways and bearings . . . a meter-unit at each bearing apportions the required clean oil-film to the moving part automatically.

what it can do for you

A Bijur system increases production by eliminating down-time for oiling . . . cuts maintenance costs by reducing bearing wear . . . protects investment by lengthening effective machine life. It has done these things for the leading manufacturers of machine tools, printing presses and business machines. It can do the same for you.

For further details, write for Bulletin 4A

2399

Bijur Lubricating Corporation
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SHELDON • HARDINGE • CLAUSING
ELGIN • CRAFTSMAN LATHES, ETC.
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MANY COLLET CHUCK ATTACHMENTS

HEX OR SQUARE Collets needed for that new job? Then say *"PRECISION Collets, please!"* to your industrial distributor. You'll get them now when you want them . . . from stock. And you'll get them as you want them . . . ground dead true, with a spring temper that spells assured performance, and with long life guaranteed.

PRECISION Collets fitting most popular machines and attachments are stocked in ROUND, HEXAGON and SQUARE sizes. Order them from leading distributors thruout the country, who serve industry well.

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"FLUIDMOTION", an exclusive J & S development, automatically blends any combination of angles and arcs in **one** continuous motion, with **one** setting, using **one** *handle*. Produces clean, precise form without tool or chatter marks. Available in models C, E and F . . . also the Form Master, an accurate lower priced dresser. Send for folder.

Fluidmotion **FEATURES**

- *automatic centering*
- *.0001" accuracy*
- *one setting per form*
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- *large radius range*
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- *chatterless*

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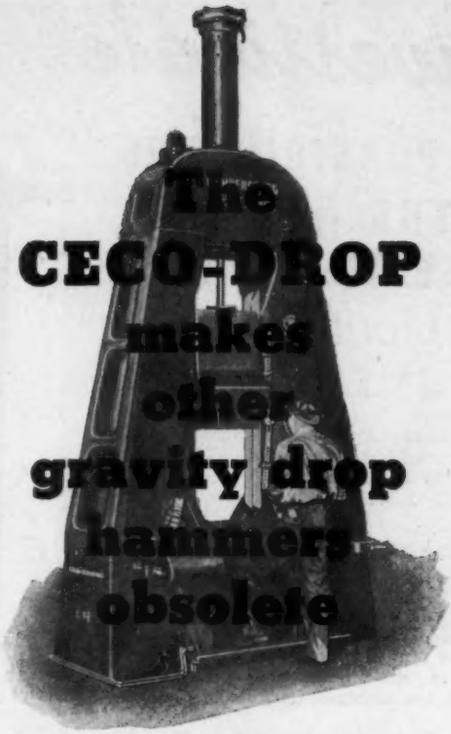

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Super - Sensitive Fixed Center Multiple Drilling Heads
Fixed-Center Auto-Reverse Multiple Tapping Heads
All Parts Fully Enclosed to Insure Pressure Lubrication and Rigid Support of Adjustable Spindles
ADJUSTABLE MULTIPLE SPINDLE DRILLING HEAD

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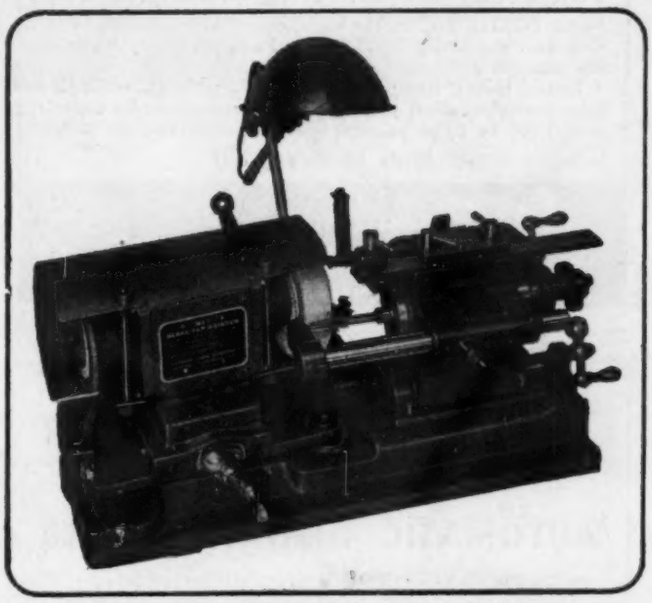
ATTENTION: MACHINE SHOP FOREMEN

Are these "unpleasantnesses" happening in your department?

1. LOW PRODUCTION from your tapping machines? Machines idle while waiting for sharp taps?
2. Taps producing IMPERFECT THREADS due to incorrect sharpening?
3. Tap COSTS HIGH because of tap breakage, low tap life?
4. TAP SHARPENING a SLOW, lengthy operation requiring skilled labor?



THE PERFECT SOLUTION TO YOUR TAP PROBLEMS . . .

IS THE BLAKE TAP GRINDER—the fastest-sharpening, easiest-to-use and most accurate chamfer tap sharpener you can buy?

IT'S *FAST:* Turning a crank *revolves* the tap in a unique eccentric movement—to grind both the chamfer and the relief in one *continuous* operation.

IT'S *EASY:* As easy as sharpening a pencil.

IT'S *ACCURATE:* Full mechanical controls eliminate the human element.

You'll also like other BLAKE features: How you can hold taps on centers, on the O. D. of the thread, or on the shank. How you can sharpen taps with 2, 3, 4, 5, 6, 8 or 10 flutes.

Get the full details by sending the handy coupon today.

Send us the Coupon below for complete details.

Please send me a free copy of Bulletin which gives complete details on the Blake Tap Grinder. A.M.

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BLAKE TAP GRINDERS—FILTAIRE PORTABLE DUST COLLECTORS—AMERICAN TOOL HOLDERS—BLACK DIAMOND PRECISION DRILL GRINDERS—WALTHAM CUTTER SHARPENERS

MECHANICAL MUSCLES

FOR EVERY LIFTING AND CARRYING JOB

Install PORTELVATOR. The Hamilton portable elevating table. One man can safely lift and carry loads previously requiring the strength of four.

Raises, lowers, transports. Three table surfaces. Accessible from four sides. Four point support. Standard model capacities, 1,000 to 5,000 pounds. Special models built on order.

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THE POSSIBILITIES OF THE NATIONAL KEYSEATING MILLER *on Your Work*

Several widths of cutters can be used with each size miller and many different hole diameters keyseated with one tool through the use of eccentric bushings.

• Shops all over the country are solving difficult keyseating problems by chucking this attachment on their drill presses, radials and horizontal boring mills—and milling keyseats in pieces too large or bulky for convenient handling on keyseating machines.

The "National" goes through the hole once and mills keyseats with parallel sides and parallel with the axis of the bore. It's a big time and money saver and is available in standard stock diameters from ½" to 3½" for cutting lengths from 1⅞" to 12". It will keyseat in blind holes, and offset Holes. We also manufacture oil-grooving millers.

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For Quantity Turning

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AUTOMATIC TURNING LATHES

Maximum output with minimum effort

Takes full advantage of tungsten carbide tools

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Cut Production Time

WITH

NICHOLSON EXPANDING MANDRELS

Set of 19 does work of 209 **solid arbors,** thus saving the time lost in making or looking for them. For all bores 1" to 7". Hardened tool steel. Sold singly or in sets. Bulletin 1043.

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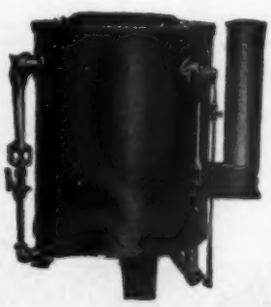
ATTAINS 1650° F. QUICKLY
Atmospheric Pot Hardening Furnace



"BUZZER" HIGH SPEED *Gas* FURNACES

. . . are the efficient, economical answer to today's Heat Treating Problems. **NO BLOWER or OTHER AUXILIARY POWER are needed . . . just connect to your gas supply.**

• The Full Muffle Furnace attains a temperature of 2400° F., and The Pot Hardening Furnace, tangentially fired, assures quick even heat up 1650° F. Many other models available.

• Send for the "BUZZER" Catalog showing full line of Industrial Gas Furnaces, Burners and other equipment.

CHARLES A. HONES, INC.

121 So. Grand Ave. Baldwin, L. I., N. Y.

ATTAINS 2400° F. QUICKLY
Full Muffle Furnace

THE FACTS—Mild steel plate 4 ft. wide by 17½ ft. long by 4 ft. thick. Total stock removed, 1610 pounds. Time, 7 hours.

ARE YOU INTERESTED IN MACHINING LARGE WORK

If you are one of the many interested in grinding work of this type, investigate the new "Bridgeport" No. 95 Face & Surface Grinder. This new grinder, shown above, with capacity to grind work up to 20 ft. long by 4½ ft. wide, can handle jobs formerly machined by other less efficient methods. The result—faster stock removal, lower cost, improved finish.

SUCH AS

Plastic Mold Plates
Press Platens
Die Blocks
Large Castings
Weldments

Note these features

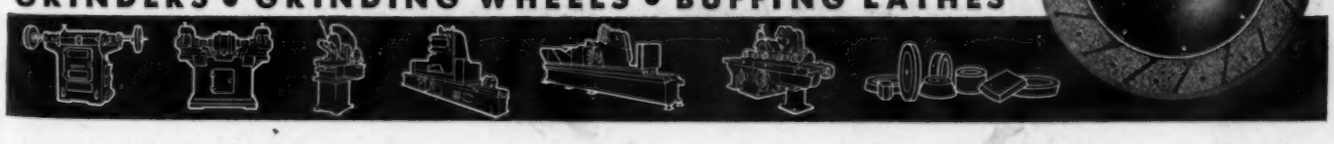
1. *Ample power and rigidity to handle heavy work—*
2. *Table reciprocated by hydraulic cylinders, affording fast, shockless reversal—*
3. *All controls mounted in central panel for operator convenience—*
4. *Spindle bearing construction with two Timken bearings, one 12 and one 9½ inches in diameter—*
5. *"Bridgeport" Sectional Grinding Wheel 60 inches in diameter, for rapid, economical grinding—*
6. *Automatic wheel feed for fast production.*

Our engineers will gladly assist in solving your grinding problems. Write us today.

THE BRIDGEPORT SAFETY EMERY WHEEL CO., INC., BRIDGEPORT, CONN., U. S. A.

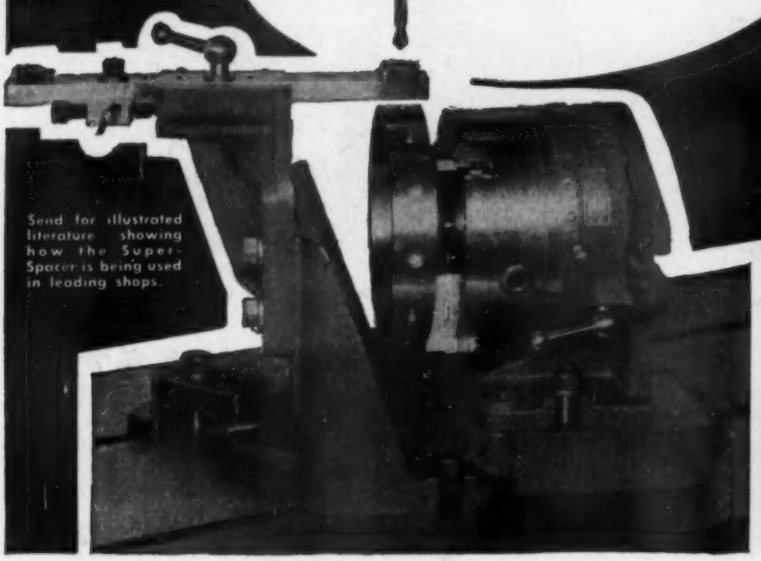
Bridgeport

GRINDERS • GRINDING WHEELS • BUFFING LATHES



Radial drilling involving indexing is simplified with the.....

HARTFORD SUPER-SPACER



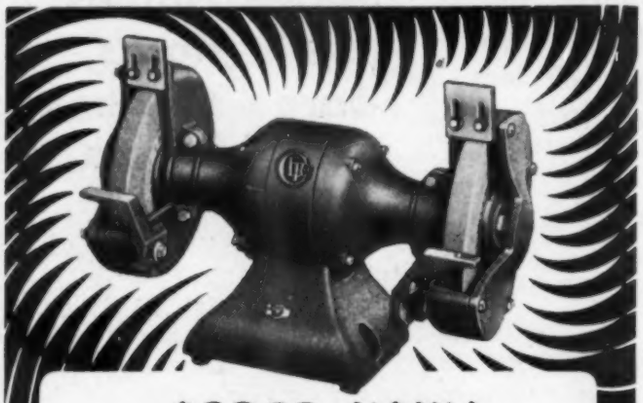
Send for illustrated literature showing how the Super-Spacer is being used in leading shops.

Set-up time and indexing time are reduced with the Hartford Super-Spacer. All chance of error in indexing is eliminated by mask plates.

The scope of utility of this modern spacing device is extended to radial drilling, by the use of the Hartford Radial Drill Attachment as shown here. With this attachment, variations in length and diameter can be quickly and easily handled.

Other uses of the Super-Spacer include plain drilling, milling, grinding, jig boring, planing and slotting. No special skill is required to operate this accurate indexing device.

THE HARTFORD SPECIAL MACHINERY CO.
Hartford 5, Conn.



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● Our stepped-up production on grinders, both bench and pedestal types, has greatly speeded up our deliveries. We can now offer exceptionally good delivery on 6, 7, 8, and 10 inch bench and pedestal grinders. Orders will be filled in the order of their receipt. **ORDER NOW!**

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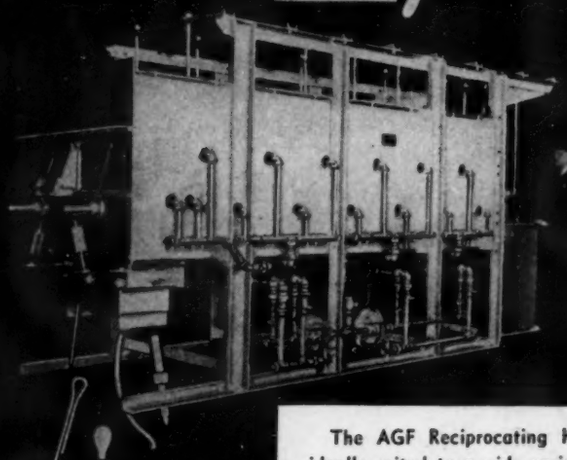
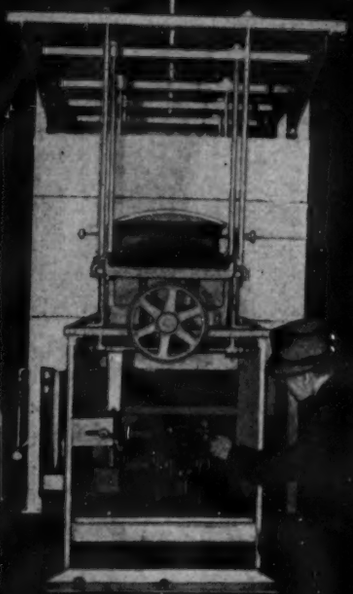
Work only enters and leaves--

the heating chamber of this latest and largest reciprocating hearth Heating Machine.





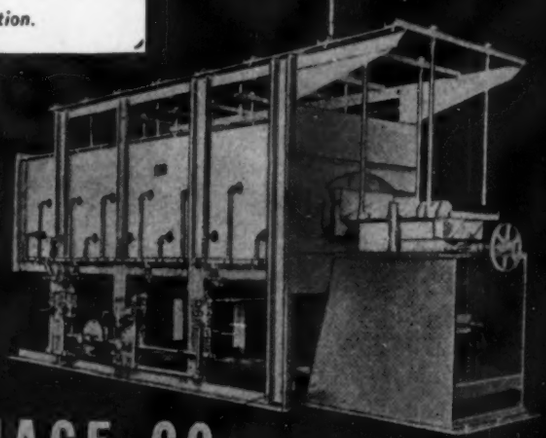
The AGF Reciprocating Heating Machine is ideally suited to a wide variety of work, that is, continuous clean hardening, annealing, normalizing, Ni-Carbing, etc.

The unit is so constructed that only the work enters and leaves the heating chamber, thus eliminating the conventional type of conveyor belt that would be alternately heated and cooled. Work introduced into the reciprocating muffle is conveyed through the heat by its own momentum. The elimination of conveying mechanism from the heating chamber reduces maintenance problems and heat losses to a minimum.

AGF Reciprocating Heating Machines are available in five standard sizes with capacities ranging from 10 to 1200 pounds per hour.

Among prominent users of these standard sizes are manufacturers of special screws, machine tools, springs, pliers, chucks, etc.

Write for complete information.



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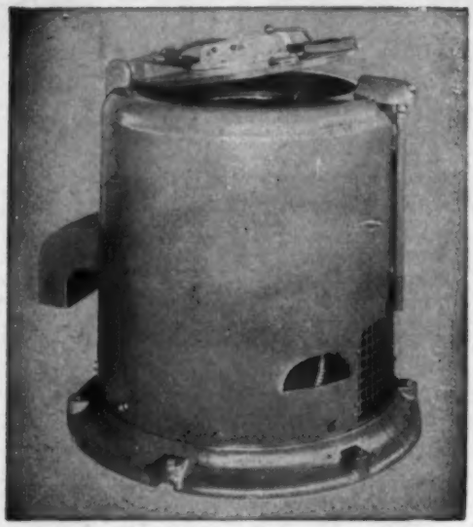
DRY SMALL PARTS QUICKLY and ECONOMICALLY with BARRETT CYCLONE CENTRIFUGAL DRYERS



The Barrett Centrifugal Dryer — efficient, self-contained, and compact is built in several sizes.

• The Barrett Parts Drying Process centers around a method of creating a guarded cyclone.

In operation, parts to be dried are placed in a well ventilated motor driven rotating basket. Free liquid is immediately thrown off by centrifugal force and any moisture remaining on parts is absorbed in the shortest possible time by the large volume of expanded air continually forced over and through the contents. Provision is made for heating and expanding, also boosting the flow of incoming air to assure faster absorption of moisture. With the large exhauster provided, heated air is not always required.

Direction of basket rotation can be quickly reversed which will change position of the load and accelerate drying. Baskets are available in shapes which experience has shown to be most effective for handling various classes of work.

It will pay to investigate the advantages offered by Barrett Centrifugal Dryers on your work.

Full Details of the Barrett Cyclone Dryer Sent Promptly on Request.

THE LEON J. BARRETT COMPANY, 1800 Grafton Road, **WORCESTER, MASS.**

Designers and Builders of Centrifugal Machinery

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PISTON RINGS

for

IMPACT MACHINERY

MADE OF HIGH QUALITY ALLOY STEEL

ELECTRONICALLY HEAT-TREATED

CECO RINGS

Designed and manufactured by the builders of Chambersburg Hammers.

a. Retain their spring and size
b. Operate satisfactorily for two or three times former life
c. Avoid excessive downtime for maintenance
d. Quick delivery

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For cutting internal keyways, slots or splines 1/16" to 4" wide and up to 60" long. Fast—Accurate—Flexible. Write for particulars and catalog on machine for your work.

Giant KEYSEATERS

MITTS & MERRILL
913 Tilden St.
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LUERS Patented Cutting Off Tool Holders
Patented Cutting Off Blades

ONLY the PATENTED construction of LUERS cutting off BLADES permits normal expansion of bursting chips — MEANS MAXIMUM CUTTING EFFICIENCY.

Manufactured By
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Save Hands Speed Production with—

LITTELL

Pres-Vac Safety Feeder

KEEP workmen's hands out of Danger Zone. Use PRES-VAC Safety Feeders to keep hands safe, improve quality and speed production. Pres-Vac acts on trigger-vacuum principle. Picks up—drops—material instantly. Uses compressed air, 10 to 45 lbs. pressure.

Littell makes a complete line of pressroom equipment, including: Reels, Roll, Dial and Magazine Feeds; Straighteners; Air-Blast Valves; Scrap Winders, etc. *Request Bulletins.*

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BOYAR-SCHULTZ PROFILE GRINDERS

Fast, Accurate CONTOUR GRINDING

IN THE TOOL ROOM ... IN PRODUCTION

Boyar-Schultz Profile Grinders save time in grinding inside and outside contours, irregularly shaped profiles, die clearances and many other difficult grinding tasks.

Boyar-Schultz No. 2 Profile Grinder—A heavy duty floor model available with single or dual spindles which turn at 10,000 R.P.M. with vertical oscillations. Rapid stock removal even with wheels as small as ½" diameter. Uses wheels ½" to 3".

Boyar-Schultz No. 1 Profile Grinder—Bench model. Spindle speed of 20,000 R.P.M. with vertical oscillations. Accommodates wheels ⅛" to 1" diameter. A highly efficient tool that performs in minutes, much of the work that formerly required hours.

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Marks FASTER BETTER CHEAPER

SPEED MARKING AT ITS BEST

This Noblewest Rapid Precision Marking Machine is not only *streamlined* in appearance, but gives you *streamlined* performance in speed, quality of marking, at lower costs. Production speeds are practically unlimited. It can be tooled for marking many sizes and shapes of pieces. Employs the famous Noblewest *rolling process*. Model 157 shown here with pneumatic die pressure. Write Noble & Westbrook Manufacturing Co., 17 Westbrook St., East Hartford 8, Conn.

☛ ***MARK IT BEST WITH***

NOBLEWEST

Precision Marking Machines

••FOR MANY A SMALL BUSINESS

This Superb Plant Offers Exceptionally Favorable Conditions for Manufacturing Nearly Any Product

ALL UTILITIES AND SERVICES . . . ADAPTABLE SPACE
MODERATE RENTALS . . . PRIME LOCATION

Here is an outstanding opportunity for a broad range of manufacturing organizations to place their operations in a highly favorable industrial location and to participate in the profit potentialities of this modern industrial community.

War Assets Administration now offers space for lease in the great government-owned manufacturing plant at Kansas City—a plant generally acknowledged as one of the finest industrial structures ever built. The leases will be for periods up to 10 years, subject only to simple, straightforward stipulations in the interest of National Defense. Leases will be based on floor area and space requirements. The plant was originally built and operated for the production of Pratt & Whitney aircraft engines. It is offered for lease on a multiple tenancy basis, permitting smaller industrial organizations to share a common roof and common utilities and services and, at the same time, have the advantages of adequate space, proportionately equitable rentals and selected location.

The space to be leased aggregates nearly 3,000,000 sq. ft. in six buildings, all modern, all designed for maximum efficiency and economical operation. The over-all layout and physical plan provides outstandingly practical opportunity for many types of producers. The total productive area originally allowed for employment of 20,000 people, many of whom want to go back to work in this plant for you.

Building clearances and arrangements permit unusually broad ranges of machinery and equipment layouts and overhead work space. Personnel facilities, locker and washroom space, and other elements, are of superior design.

This plant is situated at Troost Avenue and Bannister Road (95th Street) and has spur track and three sidings of the Missouri Pacific Railroad. Paved roads lead to arterial highways. There is barge service at Kansas City to the Mississippi. Water is supplied by Kansas City; sewers are in and connect with the city system; power and light is furnished by Kansas City Power & Light Company and natural gas by Panhandle Eastern Pipe Line Company.

The advantages of a Kansas City, Missouri, address are well known. Whether you have a small or large operation, you have the advantage here of an established, growing market, fine transportation and economical distribution. Kansas City has a top reputation as a good town to live in, to work in, to sell from.

Already there are mounting *bona fide* inquiries for rental of space in this superb industrial community. Business and labor of Kansas City are for it, and will be for every tenant.

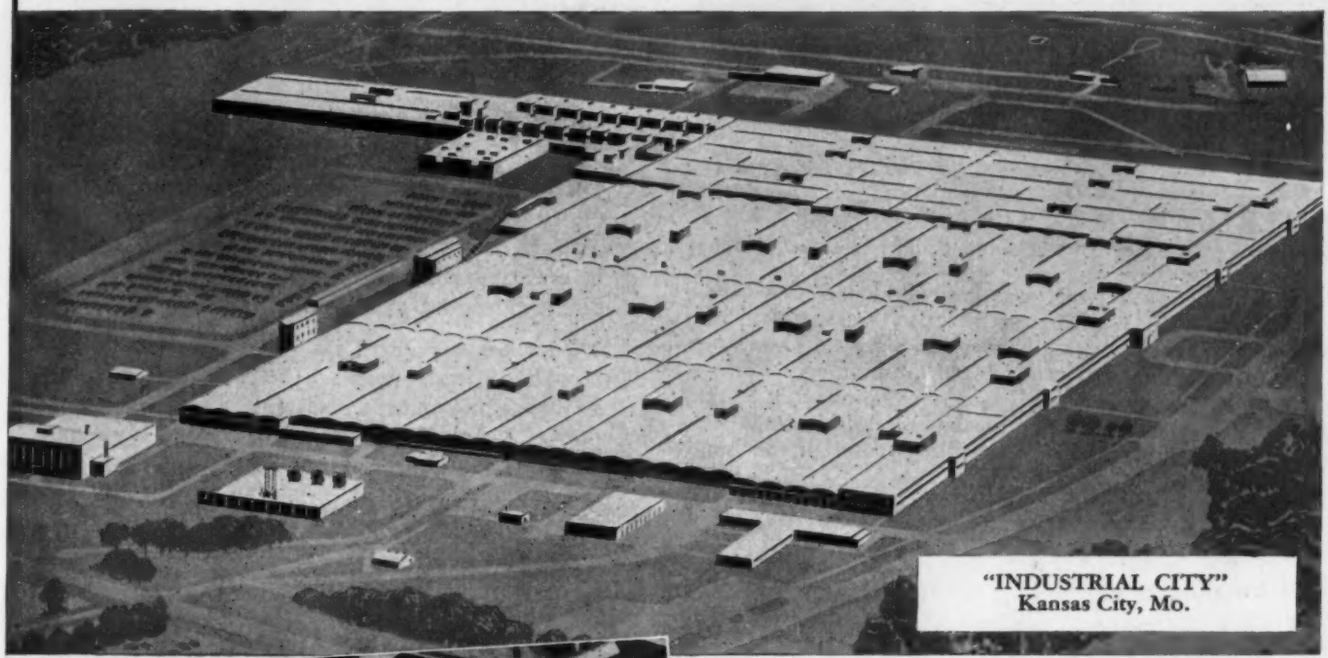
WAR ASSETS ADMINISTRATION
OFFICE OF REAL PROPERTY DISPOSAL

GOVERNMENT WAA SURPLUS

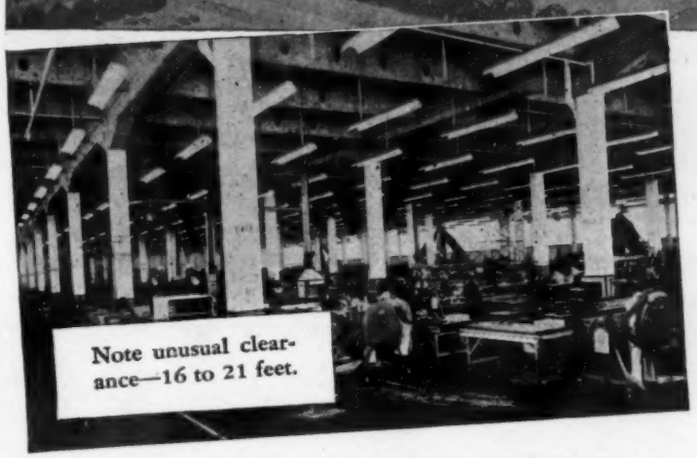
Post Office Box 1037, Troost and Bannister Road (95th Street), Kansas City, Missouri, Telephone: Delmar 3500

1038-T

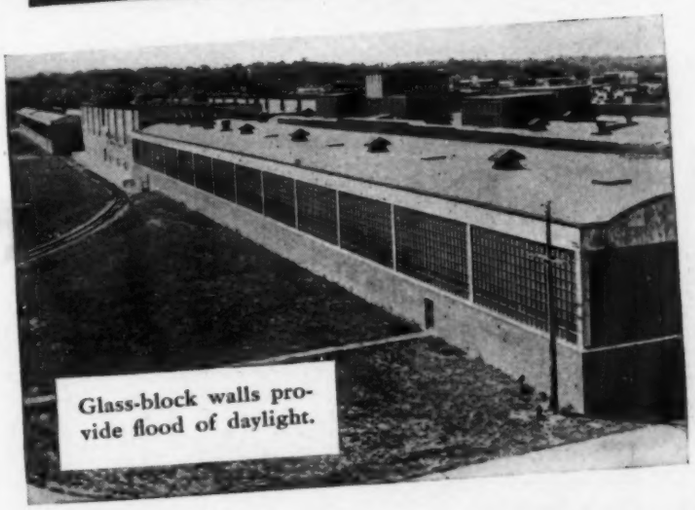
HERE'S OPPORTUNITY WITH A CAPITAL "O"••



"INDUSTRIAL CITY"
Kansas City, Mo.



Note unusual clearance—16 to 21 feet.



Glass-block walls provide flood of daylight.

INVESTIGATE "INDUSTRIAL CITY"

A special factual brochure, entitled "Industrial City", has been prepared to help you judge the suitability and advantages of this fine, modern facility as a home for your business. It describes the many ways in which the space you may want can be organized for profitable production. It contains full information on the favorable rental basis—tells you how to go about acquiring space in this premier structure.

Write for your copy of "Industrial City" brochure today. Send your inquiry direct to War Assets Administration, Office of Real Property Disposal (P.O. Box 1037), Troost and Bannister Road (95th Street), Kansas City, Missouri.

This great property may be personally inspected any business day. Your own engineers and experts can make arrangements to study every aspect of the property to determine its advantages for you. Representatives are on the spot to answer all questions and help in working out arrangements to meet your specific requirements.

Title to the property will remain with the Federal Government and the Navy Department in the interest of national security.

The set of books that makes

MASTER MACHINISTS

and leads to bigger pay!

This big home-study and reference course gives you the practical facts on machines and methods you need to advance in machine shop work. Take advantage of the other man's experience as found in books, to solve your problems, increase your efficiency with

AMERICAN MACHINISTS' LIBRARY

6 volumes, 2516 pages, 2368 illustrations, many charts and tables

THESE books answer your questions on methods and machines—tell what you need to know about the operation of machines of all types and sizes for the whole range of metal cutting, forming, and finishing operations—show by text, diagram, and illustration the essential points of setting up work, adjusting machines, selecting feeds and speeds, determining pressures, handling materials, devising short-cuts, etc.

Puts the mastery of machine-shop work at your fingertips

With these books at hand for quick reference, no job is too hard or unusual, and the routine jobs may be improved, with savings in time and trouble and reduced wastage.

What the Library gives you

—complete guide for everybody, from shop executive to apprentices, interested in the operation of machines used in turning and boring practice

—description of all important varieties of machine, both manual and automatic, and methods of operating them

—data on speeds and feeds, new cutting alloys and materials, use of coolants, etc.

—practical information on grinding machines and abrasive wheels, showing what they do, how to operate them, and how to make best use of them on various types of work

—training in the various operations performed in drilling and surfacing materials in the machine shop

—exact, descriptive data on all aspects of gear-cutting practice, useful in shops of any size

—essentials of selecting machines, setting up work, and handling operations in reaming, tapping, planing, shaping, slotting, milling and broaching.

No Money Down — Easy Payments

Let us send you these fact-packed books for 10 days' examination, with no obligation to buy the books unless you want them. Remember that if you decide to keep the books the special library price represents a saving of $2.50 on the price of the books if you were to buy them separately. Furthermore, you may have the privilege of paying in small monthly installments, while you use the books. Invest in life's soundest commodity—KNOWLEDGE. Send the coupon today.

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Send me the American Machinists' Library, 6 volumes, charges prepaid, for 10 days' examination. If I find the books satisfactory, I will send you $4.00 in 10 days, and $4.00 a month until the special price of $20.00 has been paid. Otherwise I will return the books postpaid. (To insure prompt shipment write plainly and fill in all lines.)

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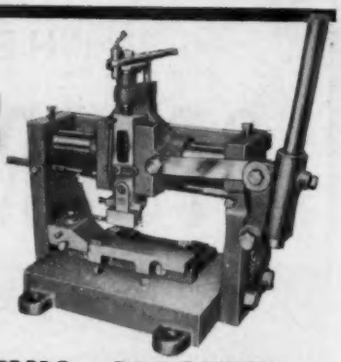
the

FORCE



E.P.1 MARKING MACHINE

AN inexpensive production machine especially adapted for marking on cylindrical pieces. Uses solid dies or dependable FORCE Interchangeable Steel Type which permits quick changing of the marking code.

There is a FORCE device for every metal-marking requirement. Send for free catalog of indenting and embossing numbering machines, steel stamps and dies, steel type and holders, hand and power presses, rotary marking machines, etc.

WM. A. FORCE & COMPANY
INCORPORATED
216 NICHOLS AVENUE, BROOKLYN 8, NEW YORK, U.S.A.

The FORCE Line of NUMBERS

HOLMAN BETTER, FASTER HOLE FINISHING

HELICAL TAPER PIN REAMERS

Scientifically made of selected steel under modern processes. Long lived, economical, accurate. Details on request.

HOLMAN REAMER CO.
MANCHESTER, CONN.

Machine Tool Show

Chicago

September 17-26

CONTRACT WORK

WANTED PRODUCTS OF CONTRACT WORK

Machinery manufacturing concern with extensive experience desires a product to manufacture on a contract basis or straight contract work.
Manufacturer has modern well equipped machine shop, capable of making small, medium or large machinery, tools, jigs, fixtures, gages, stamping dies, stampings, electronic assemblies, gear drives and small parts of all types. Excellent engineering facilities and good contacts for all types of foundry work are available.

Send for our bulletin #10A

C. W. JARVI MFG. COMPANY, INC.
NORTH ATTLEBORO MASSACHUSETTS

OPEN CAPACITY for HEAT TREATING

ELECTRIC FURNACE
We can handle anything in High Speed Steel up to 7" High, 12" Wide, 22" Long regardless of shape.

GAS FURNACE
Flats to 44" Diameter—Discs—Shear Plates—Washers. We specialize in holding discs flat.

Quality Work—Prompt Deliveries. Write or Wire.

THE MOTCH & MERRYWEATHER MACHINERY CO.
PENTON BLDG., W. Third and Lakeside Ave., CLEVELAND 13, OHIO

SCREW MACHINE and TURRET LATHE PRODUCTS

Planer and Hor. Boring Mill Work. Castings Available. Gears, Sprockets, Jigs and Fixtures. Quick Delivery. Send B. P. For Quotations.

LEMBO MACHINE WORKS
154-156 East 23rd St., Paterson 4, N. J.

WANTED — CONTRACT WORK

Metal Fabrication Manufacturer with extensive production experience has additional capacity in small welding plant. Can perform sawing, flame shape cutting, drilling and welding operations. Send your inquiries or drawings to

THE B-H CO., INC., CAMBRIDGE CITY, IND.

PURCHASING AGENTS!

Farnham machines do the job! Aircraft war work gave us valuable experience in fabricating light metals, enabled us to design new machines for this work. Call on FARNHAM with your problem in special machinery.

FARNHAM
MANUFACTURING COMPANY
1646 SENECA ST. • BUFFALO 10, N. Y.

THREAD ROLLING, INC.

Precision Threads and forms. Class 3, 4 and 5 threads, Aviation Products. Diesel Studs. Taps. Hollow Parts, etc. Threading after heat treating. Prompt Quotations from Blue Prints.

332 Grand Street, Hoboken, N. J.
HOBOKEN 4-1826

- Plates—Flame cut to size and shape—latest burning equipment. Can furnish our own steel—accurate work—prompt service.
- Equipped to do welding and fabricating in connection with this service. Send us blueprints or templet for quotation.

THE TOLEDO IRON AND STEEL CO.
A Complete Steel Warehouse Service
1819 STARR AVENUE, TOLEDO 5, OHIO

SEND B.P. FOR MFG. COMPLETE ASSEMBLIES
Tool—Jigs—Dies
Screw Machine and Turret Lathe Work
Stampings—Gears

POSSY'S TOOL & MFG. CO.
51 Meadowbrook Buffalo 6, N. Y.

Put Your Idle Capacity to Work

Hundreds of metal-working companies are finding profitable business today outside their regular lines. Tell metal-working America—the 100,000 readers of American Machinist—about your facilities. Write for rates.

CONTRACT WORK DEPARTMENT
AMERICAN MACHINIST
330 W. 42nd St., N. Y. 18, N. Y.

PATTERNS in WOOD and METAL
For All Kinds of Castings, Large or Small
MATCH PLATE WORK A SPECIALTY
Put your pattern problems up to us – we will take care of them.
GENERAL PATTERN WORKS
2233 Buck Street Cincinnati, Ohio

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

WORKS MANAGER

Take full charge of an Aluminum and Brass Foundry, also operating a modern machine shop, located in the south. Must be able to get along with southerners and be willing to undergo a rigid investigation before hiring. Send full information. Salary $7000 to $10,000 per year.

THE ENGINEERING AGENCY, Inc.
EST. 1893
53 W. Jackson Blvd.
Chicago 4, Illinois

SALES ENGINEER

To contact machinery and mill supply houses on established line of motor driven, grinding (lathe, bench, snagging), buffing and polishing machines. ½ H.P. to 50 H.P. State territory covered, experience, qualifications, age, lines handled, etc. Commission basis. Replies held strictly confidential.

P-948, AMERICAN MACHINIST
520 North Michigan Ave., Chicago 11, Ill.

POSITIONS VACANT

PROCESS ENGINEER—Machine Shop and Assembly—Well managed and profitable company, manufacturing non-ferrous metal parts, seeks Process Engineer with broad experience automatic machinery process, high speed conveyorized assembly and special purpose machining operations. M.E. degree. Salary about $7,000. P-961, American Machinist, 330 W. 42nd St., New York 18, N. Y.

CHIEF TOOL Designer—Company manufacturing non-ferrous metal parts desires Chief Tool Designer with experience in design of tools for automatic screw machines, turret lathes, patterns, core boxes and assembly tools. Salary $6000 to $7000. P-962, American Machinist, 330 W. 42nd St., New York 18, N. Y.

SUPERINTENDENT—FACTORY—Experienced foundry, machine shop, automatic polishing and buffing, high production plants. Salary about $9000. P-963, American Machinist, 330 W. 42nd St., New York 18, N. Y.

EXPERT INSTRUMENT Maker wanted by research laboratory of major oil company located in the Southwest. Experience in making instruments for geophysical exploration desirable. In reply give summary of experience and salary expected. P964, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

Additional Employment Advertising on page 296

WANTED ENGINEER or DESIGNER

We want a mechanical designer or engineer who has had direct experience in the production of carpenters tools, particularly bit braces, spiral screw drivers, hand drills, etc. Must be a competent draftsman with sufficient shop background and inventive ability to design and integrate all production tooling and products. Small company with excellent future prospects located southern Connecticut. Salary open.

P-959, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

REPRESENTATIVES WANTED

Progressive manufacturing concern specializing in screw machine products, stampings, and mechanical and electrical assemblies desires representation in areas other than New England and Middle Atlantic States. Diversified, up-to-date equipment affords capacity for wide range of jobs. Address

RW-958, AMERICAN MACHINIST
330 West 42 St., New York 18, N. Y.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATES

(Not available for equipment advertising)

60¢ per line, minimum 4 lines. To figure advance payment count 6 average words as a line

POSITIONS WANTED (full or part-time individual salaried employment only), ½ above rates.

PROPOSALS. 50 cents a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not incldng proposals.)

DISPLAYED RATE:

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches to a page. A.M.

NEW ADVERTISING received by 10 A. M. June 17 will appear in the issue of July 3 subject to limitation of space available

WANTED

MARINE ENGINEER

Must have technical education and experience in design and development of tugs, dredges etc. for inland river operations. Propeller design experience also required. Must be capable of rapid and accurate work under general supervision. Reply by letter only giving all relevant details as to age, education, positions held, design achievements etc. Work located in the Pittsburgh, Pennsylvania district.

P-960, AMERICAN MACHINIST
330 W. 42nd St., New York 18, N. Y.

WANTED

SALES ENGINEER

To act as Representative for leading, well rated, Mid-west gear manufacturer. Prefer representation by men who have a knowledge of gears or who are selling similar component parts.

Territories open include: Schenectady-Albany area; Philadelphia; Pittsburgh; Michigan and West Coast. Earnings on straight commissions are potentially very high. No objection to other non-conflicting lines. Your reply should provide complete details and qualifications of yourself or your organization.

RW-969, AMERICAN MACHINIST
520 N. Michigan Ave., Chicago 11, Ill.

PETITT BROS. MACHINERY CO.

If You Want to Buy, Sell, or Trade
One Machine or Entire Plant
Consult Us Immediately
FRED PETITT — ALBERT PETITT
OFFICE AND WAREHOUSE
1210 WEST 4th ST. CHERRY 0609
CLEVELAND 13, OHIO

FOR SALE

WIEDEMAN TURRET PUNCH

Type R-5—Power Operated—12 stations. Complete with motor, gauges, punches and dies. Excellent condition—only 60 days in use.

MARKET FORGE CO.
EVERETT MASSACHUSETTS

(Continued from Page 295)

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of thirty-seven years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby Inc., 443 Delaware Ave., Buffalo 2, N. Y.

POSITIONS WANTED

PLANT SUPERINTENDENT or Manager. Age 49, 20 years practical experience manufacturing light, heavy, precision, sheet metal products, tools. Dies, precision machining, stamping, forming, welding finishing, know how, mass line production, cost, continuous labor relations. Salary $7200. Location immaterial. PW-952, American Machinist, 330 W. 42nd St., New York 18, N. Y.

PERSONNEL MANAGER: 11 years experience in planning and supervising presonnel programs in steel, aluminum and foundry industries. Background of engineering education, engineering and sales work. Presently employed in administrative capacity by Federal government. Desire position with company whose basis industrial relations policy is to develop essential cooperation between management and employees. PW-965, American Machinist, 330 W. 42nd St., New York 18, N. Y.

GENERAL MANAGER. Experienced in Mechanical Engineering, Production, Tooling, Machine Tools, Foundry, Sales, Research, and Development. Graduate mechanical engineer, 13 years experience. Desire to locate with aggressive concern desiring to increase production and acceptance of products. PW-967, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER: 19 years' experience in tooling, methods engineering, estimating, time study, plant layout, and production management, with 10 years supervisory experience. Experience in sheet metal fabrication, welding—both resistance and fusion, machining, and foundry practices on all types of metals including stainless steel. Desire position as production manager or production engineer. Age 37. PW-968, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

GEAR SPECIALIST—12 years experience with gear hobbers and threadmillers, who is capable of analyzing and correcting gear, tooling, and machine troubles desires position with gear manufacturer. Experienced in spline, spur, helical, and worm gearing; milling worms, threads, and leadscrews. PW-966, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITY WANTED

EXPERIENCED SUCCESSFUL salesman and sales executive with engineering background and varied practical production experience will be valuable to you. Available soon. SA-956, American Machinist, 520 N. Michigan Ave., Chicago 11, Ill.

BUSINESS OPPORTUNITY

Mechanical Engineer. 20 years shop, design, and sales experience wishes to invest $20,000 and services in small going manufacturing business. BO-957, American Machinist, 330 W. 42nd St., New York 18, N. Y.

PATENT ATTORNEY

PATENT and Trade-Mark Practice before U. S. Patent Office Validity and Infringement Investigations and Opinions Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommel, Registered Patent Attorneys, Suite 453, 815-15th Street, N. W. Washinton 5, D. C.

WANTED

ANYTHING within reason that is wanted in the field served by American Machinist can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

MANUFACTURER'S REPRESENTATIVE
in INDIA — BURMA

Well established representative desirous of contacting leading American manufacturer interested in representation and distribution in India and Burma. Excellent bank references.

P. K. PATEL & CO.
P. O. BOX 88, BARODA (INDIA) CABLES PIKE

REBUILDING

Machine service engineering 15 yrs. experience servicing, repairing and reconverting engine lathes, turret lathes, milling machines, shapers, surface grinders and boring mills.
Write or wire your problems for dependable service

F. L. ACKERMAN
346 S.W. 3rd St., Pendleton, Oregon

RIVETING MACHINES

New and used riveters at below market prices:

SEE OUR LISTS

MONTGOMERY ENGINEERING CO.
672 W. Hancock Detroit 1, Mich.

FOR SALE

Rogers vertical boring mill, 36"

New in 1943. Good condition, reasonable price.

KATO ENGINEERING COMPANY
Mankato Minnesota

We Have Declared Surplus

Punch Presses, Centerless Grinders, Milling Machines, Automatics, Lathes and various other equipment. For Complete List Write:

Billard Machine & Tool Co.
MANSFIELD, PA.

Are You Seeking or Offering

— business

— equipment

— employment

"OPPORTUNITIES"?

To fill any of these "industry wants" a logical source is found in this Searchlight Section—Classified Advertising.

Experience has shown that the Searchlight Section produces quick results because it spotlights current opportunities of special interest to the readers of AMERICAN MACHINIST—management and production executives in the metal-working industry.

Use "Searchlight"—at low cost—to feature your wants or offerings . . . whether it concerns employment, buying or selling used or surplus new equipment, or other pertinent business "opportunities."

EVERY ITEM GUARANTEED AS REPRESENTED

FALK FOR DEPENDABILITY IN REBUILT MACHINERY

AUTOMATICS

2—#00 Brown & Sharpe Full Automatic, Standard Speed

1—1¼" Cone 4-spindle Automatic, Motor Driven, Threading Spindle

1—#515 National Acme 9/16" 4-spindle Automatics, complete

LATHES

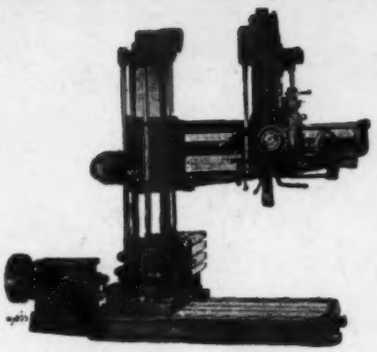
10"x24" Logan Q.C.G. Lathes (new)
Sebastian Engine Lathes (new)
14"x6' Hendey Yoke Head
14"x6' Rockford Cone drive (two)
16"x6' American Motor Driven Lathe
16"x8' Lodge & Shipley 12-speed Grd. Hd.
16"x8' Monarch Geared Head Lathe
18"x10' American, Geared Head, Taper
18"x6' American Q.C.G. motor drive
20"x10' American Q.V.G. motor drive
20"x11' Schumacher-Boye, M.D.
24"x12' LeBlond Heavy Pattern
26"x18' Bridgeford geared head
28"x10' Davis cone driven
32"x16' Bridgeford geared head

TURRET LATHES

4—#4 Warner & Swasey Hand Screw Machines, arr. Motor Drive
2—#4 Warner & Swasey Universal Turret Lathe, Motor Driven
16" Warner & Swasey Brass Lathe
#2A Warner & Swasey Universal
#3A Warner & Swasey Universal, motor drive
#4 Foster GFH Hand Turret Lathe
3—Morey #2G Geared Head Turret Lathe, motor drive (late model)
2—Simmons #2 (microspeed) Turret Screw Machine (late model)
Bullard 42" Vertical Turret Lathe
Brown & Sharpe #1 & 2 Hand and Screw Machines

PLANERS

Betts 120"x72"x35' Metal working Double Housing Planer. Equipped with: 4 heads and power rapid traverse. With motor drive and controls, bed is 61' 3½" long
20"x20"x24" N.B.P., Planer Shaper
26"x26"x8' Gray Planer, 2 heads



RADIAL DRILLS

3½' Arm, 10" Column Cincinnati-Bickford
4' Arm, 11" Column Cincinnati-Bickford
5' Arm, 13" Column Cincinnati-Bickford
5' Arm, 14" Column Fosdick, motor drive
6' Arm, 15" Column Cincinnati-Bickford

Cincinnati-Bickford 5' Arm, 13" round column with air clamp. Oil grooved, tee slotted base, side base, with plain box table with #5 Morse Taper spindle. Motor drive.

FOUNDRY MACHINES

2—#0 Johnston & Jennings, Jolt Squeezer Draw Pattern, 15"x21" Table
2—#342 Osborn Jolt Rollover Pattern Draw Moulding Machines, 23x38" Table
2—SPO Hand Rollover Power Draw Moulding Machines complete with run-out cars 22½"x60"
1—#602 Osborn Jolt Rollover and Pattern Draw, jolt cap. 900#, 36" flask length.
1—Tessmer, Sprue Cutter, 1¼" square, capacity

SHEARS & METAL WORKING

Lennox Splitting Shear, ¾" cap.; 8' throat
Lennox Bevel Shear, ¼" cap.
Peckstow 30"x18 ga. Squaring Shear
Niagara 48" Roller Leveller, 8 Rolls
West Co. 36" x 10 ga. 15" gap, Power Squaring Shear

MILLING MACHINES

#3, #4, #5 Cinn. High Power, Plain, S.P.D
#1 Brown & Sharpe Plain Miller
P & W 2½" Duplex Spline Miller
Thread Miller, Hall Planetary #1—24"
#8 Lees Bradner Thread Miller
#1, #2 Kempsmith Plain Millers
#3B Hendey Universal Miller, motor drive
#4 Cinn. Vertical High Power Miller. (2)

GRINDERS

Blanchard #16 Vertical Rotary Surface Grinder, motor drive
Pratt & Whitney 14" x 36" Vert. Surface Grinder, motor drive
12" No. 22 Heald Rotary Surface Grinder
16" Persons-Arter Rotary Surface Grinder
1—Seybold 96" Knife Grinder
Oliver of Adrian Drill Grinders
Cincinnati Centerless Grinders #2 M.D.
#12 Greenfield Internal Hydromatic Grinder, sizematic type
#2 Brown & Sharpe Surface Grinder
#70 Heald Internal Grinder
#60 Heald Cylinder Grinder
10"x18" Norton Cylindrical
2—Cincinnati, #1½ Tool & Cutter Grinders

BORING MILLS

3½" Bar Landis-Rochester Horizontal Boring Mill, Model #36

#31 Lucas Horizontal Boring Mill, 3" bar

POWER PRESSES

2—#1A Standard Bench Type Press, ¾" stroke
#4 Bliss D. C. Forging Press
200 ton A.C.F. Hydraulic Press. Bed. 24"x36", 4-post.
Hilles & Jones #4 Single End Punch and Shear. Equipped as Plate Shear with 18" Blades. ARR, motor drive, 48" throat
Bliss #4¾ Dble. Crank Press, 5" shaft, 4" stroke
Bliss #76½B Single Crank Geared Press, 7" shaft, 3" stroke
Horton-Ackerly, Back Flywheel Bench Presses, ¾" & 1" stroke
Caldwell, 200 tons capacity, Hydraulic Horizontal Wheel Press
Lucas 15 ton Power Arbor Press
Bliss-Consolidated #163B S.S. Dble. Crank Press
Baxendale #4 O.B.I. Power Press, 2½" stroke

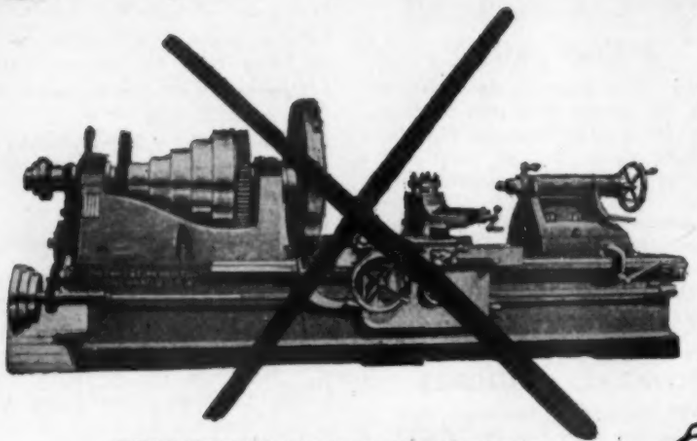
BUY FROM STOCK
Telephone
MAIN 6347-6348

FALK
MACHINERY COMPANY
Machinery Merchants

18 WARD ST.
ROCHESTER 5
N. Y.

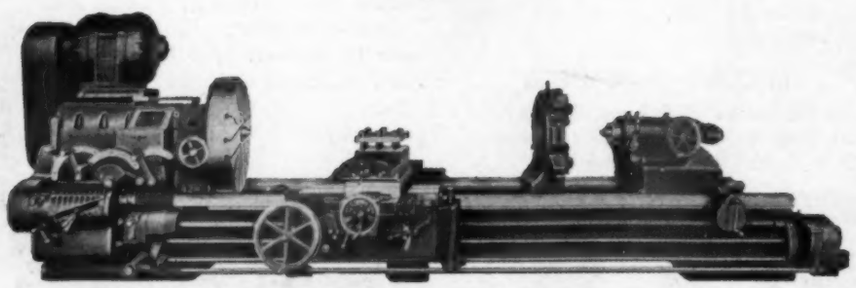
MOREY

MODERN MACHINE TOOLS
LOW PRICES



ENABLES YOU TO REPLACE
OBSOLETE EQUIPMENT

WITH —this!



MODERN—LATE TYPE MACHINE

NEARLY

AUTO. SCREW MACHINES

ACME GRIDLEY Model RA-6, 2", Latest Type
BILLINGS & SPENCER B-2 Diametic—Latest
BROWN & SHARPE #4 Highspeed, 1½" cap., Latest Type
CLEVELAND ⅜" to 2¼" Model A
CONOMATICS 3½" 4 spindle—latest type
CONOMATICS 2½"—6 spindle, Latest Type
NATIONAL ACME 9/16" mod. C, 5 spdle., M.D.

BORING MILLS—Horizontal

DETRICK & HARVEY—4" bar—floor type—motor drive
DETRICK & HARVEY—5" bar—floor type—motor drive
FRANKLIN 4½" bar, single pulley drive
LANDIS #35—3¼" bar—floor type
NILES BEMENT POND 5", 6", 7" bar—floor type
NILES BEMENT POND 4½" bar, M.D.
P & H #10, 3½" bar, floor type, M.D.
UNIVERSAL #3A—3" bar, Motor Drive

BORING MILLS—Vertical

BETTS 120"—2 swivel head, motor drive
BETTS (Consolidated) 100"—2 heads, DC, Latest Type
BETTS (CONSOLIDATED) 84" 3-heads, AC Latest Type
BULLARD 36", New Era Type, M.D.
COLBURN 72" 2 swivel heads, AC, M.D.
KING 36" Turret, MD, Latest Type
NILES 120", 2 swivel heads, PRT, M.D.
NILES 72", 2 swivel heads, PRT, AC, M.D.
NILES 100", 2 swivel heads, PRT, M.D.

DRILLS

BAKER #121 Single spindle—latest type
BARNES #H3, Hydram, latest type
BARNES #210—single spindle—latest
BODINE 42-20, 42-30 automatics—M.D.
COLBURN #14, 2 spindle, heavy duty, AC, M.D.
EDLUND #1B, #2B, #2MS, M.D.
FOOTE BURT SIPP #2, #3—single spindle—latest
HENRY & WRIGHT 2 spindle
PRATT & WHITNEY No. ½Bx50" 2 spindle, Deep Hole latest type

MOREY MODERN MACHINERY

DRILLS—Radial

AMERICAN 3½'9"—Maxi-Speed, Motor Drive
AMERICAN 4'11"—5'13" AC, M.D.
AMERICAN 5', Univ., AC, M.D.
AMERICAN 7' Triple-purpose, M.D.
CANDEY OTTO 3'11" New
CARLTON 6'15", motor on arm
CINCINNATI BICKFORD 5'13" M.D.
CINCINNATI BICKFORD 6', Univ., AC, M.D.
DRESES 5'13", 4'13" AC, M.D.
DRESES 5'15", Universal, AC, M.D.
FOSDICK 5'14", AC, M.D.
MUELLER 4½'9", 4'11" AC, M.D.
NILES BEMENT POND 6'15" uni., AC, M.D.
RYERSON 4'11" AC, M.D.
WESTERN 3', 4'18", 5'15", 6'20", latest type

GEAR CUTTING EQUIPMENT

BARBER COLMAN Type A Hobber—latest
BARBER COLMAN Type S, #3 #12 Hobber, M.D.
BROWN & SHARPE #3H gear cutter, M.D.
CROSS #73 Univ., tooth-rounder, Latest Type
FELLOWS #7, #7A type, all models, latest
FELLOWS #6, #6A type, all models, latest
GLEASON 11", 18" bevel gear generator, M.D.
GLEASON #13 tester, M.D.
GOULD & EBERHARDT 96H Hobber, M.D. with differential
GOULD & EBERHARDT 36H Hobber, M.D.
GOULD & EBERHARDT 12 H.S., Latest Type
HERCULES 24" HOBBER, differential, M.D.
NEWARK #5, 72" Hobber, Latest Type
PRATT & WHITNEY 18" Grinder, hyd.—latest type
SCHUHARDT & SCHUTTE #1, #2, Hobber, differential, infeed, M.D.

GRINDERS—Cyl.—Plain & Uni.

BROWN & SHARPE #1, #3, #4 Univ., motor drive —latest type
BROWN & SHARPE #5 Plain 3x12, LATEST

DEPENDABLE MACHINE TOOLS • PROMPT SERVICE

ALL BUILT SINCE 1941

BROWN & SHARPE #20—plain—10x18—Latest Type
LANDIS 6x18, 6x20, plain, M.D.
LANDIS 9"x18" Type C Hyd. Latest Type
LANDIS 30x220" Centers, Plain, M.D.
NORTON 14x36 Type "C", Universal, Hyd., Latest Type
NORTON 10x18 Plain—motor drive
NORTON 16x72 Plain, Type C—latest type
NORTON 16x72 Universal, HYD., Multi-purpose, Latest Type

GRINDERS—Internal Cutters & Miscellaneous

BROWN & SHARPE #10 Tool & Cutter—latest
BROWN & SHARPE #13, Universal Tool, Latest Type
BRYANT No. 16—16" Chucking—Internal—latest
BRYANT #5 Internal, hyd., latest type
CINCINNATI #2 Univ., Tool & Cutter, Latest Type
CINCINNATI #2, #4, Centerless, Latest Type
FITCHBURG Uni., spline shaft, hyd.
GLEASON #12 cutter grinder
HEALD 72A3 Sizematic internal, latest type
HEALD 72A5 plain internal, latest type
HEALD #81, Sizematic, Gagematic, Latest Type
HEALD 75A Plain, Internal, Latest Type
OLIVER Tool and Cutter, Latest Type
PRATT & WHITNEY Contour Cutter—latest type
SELLERS #4T Uni., Tool—latest type

GRINDERS—Surface

ARTER 30" Rotary Surface—Hydraulic—latest type
ARTER 8" Automatic Piston Ring
BLANCHARD #16A—Dial Type—motor drive
BLANCHARD #11, 10" Chuck, Latest Type
BLANCHARD #27-18, M.D., Latest Type
BROWN & SHARPE #2, M.D., Latest Type
HEALD #22, 12" Rotary, Latest Type
MATTISON 12x16x48 Hyd., Latest Type
MATTISON 14x16x60 Hyd., Latest Type
NORTON 10x36 Hyd., Latest Type
THOMPSON 16x30x48 Hyd., Latest Type

JIG BORER

PRATT & WHITNEY 3B, M.D., Latest Type
PRATT & WHITNEY 2A, M.D., Latest Type

LATHES—Engine & Mfg.

BETTS BRIDGEFORD 84x24' bed, AC, M.D.
BRIDGEFORD 36"x28', 36"x32' bed—2 carriages, M.D.
HARDINGE TR59, Motor Drive., Latest Type
HARDINGE 9x54" bed, QCG, Cataract
HENDEY 12x54" Centers, Engine, Latest Type
HENDEY 22x8' bed, Engine, Geared Head
HENDEY 14x8' bed, Engine, Geared Head
HOUSTON, STANWOOD & GAMBLE 36x24' bed
KEIGHLEY LIFTS 8x16x4', Gap, AC, M.D.
LeBLOND 13"x4' bed, Timken Mfg.—latest
LOSWING 4x60, 4x84, 8x60, 8x84, 8x108, Timken Bearing, Latest Type
LOSWING 5x34" Model LR Auto, Timken latest
MOREY MATTHEWS, Shaft Turning, Latest Type
NILES 30x24' Centers, Time-Saver, Timken, PRT, Latest Type
NILES 42"x60", double head, Motor Drive
NILES 48x23', 32', 34', 35', Centers, heavy duty, Timken Bearing, PRT, Latest Type
NILES 60x10', 15', 35', 40', Centers, heavy duty, Timken Bearing, Latest Type
NILES BEMENT POND 72"x62' Centers, combination Boring and Turning, heavy duty, Motor Drive
PITTSBURGH 50'x30' bed—M.D.
REED PRENTICE 20x54" Centers, Timken, Latest
REED PRENTICE 24x20' bed, AC, M.D.
WARD HAGGAS & SMITH 18x30x10' bed, Gap Lathe, AC, M.D.

LATHES—Turret

BARDONS & OLIVER #5, #7 Timken Bearing—latest type
CINCINNATI ACME #1, #5W, Timken bearing, latest type
GISHOLT #3, #4, #5 Univ., Timken Bearing, Latest Type
GISHOLT #3D Simplimatics—Timken—latest
GISHOLT #1L, #2L, Universal, Timken Bearing, Latest Type
GISHOLT #4L, 9" hole—cross sliding turret—Timken Bearing latest type
JONES & LAMSON #3, #7C Univ., latest type—Timken Bearing
LIBBY #1H-5 Timken Bearing—latest 5½" hole
MOREY 2G, #3, #4, Timken Bearing, latest
WARNER & SWASEY #4A—uni. 5" hole, timken bearing, Latest Type
WARNER & SWASEY #2, #3, #4, Univ., Timken Bearing, Latest Type

MILLING MACHINES—Mfg.

BRIGGS Type 2A, production, HYD., latest type
BROWN & SHARPE #000—Timken Bearing, Latest Type
BROWN & SHARPE #12 auto., Timken—latest
CINCINNATI 56/90 Hydromatic Latest
CINCINNATI #0-8 Vert.—Pl. Auto.—Timken Bearing—latest type—Rise & Fall
CINCINNATI 48" duplex, automatic, SPD
CINCINNATI 24" Duplex, Automatic, M.D.
CINCINNATI 24" Plain, Automatic, M.D.
CINCINNATI 4-36 Hydromatic, Latest Type
CINCINNATI 3-24 Duplex, Hydromatic, Timken Bearing, Latest Type
INGERSOLL 48x42x16', 4 heads, Planer Type, AC, M.D.
INGERSOLL 32x24x16', 2 heads, Planer Type, AC, M.D.
KEARNEY & TRECKER #1218 Auto.—Timken Bearing—latest type
MOREY #12M 2 spdle. Profiler & Milling Machine
NICHOLS Hand, M.D.—Latest Type
OHIO Auto. 16"x72" table—Timken Bearing
SUNDSTRAND #3 Rigidmill, AC, M.D.
TAYLOR & FENN M-80, Duplex Spline, Latest Type

MILLING MACHINES—Plain

CINCINNATI #3 High Speed, Dial Type, Timken Bearing, latest type
CINCINNATI #4 Timken Bearing, M.D.
CINCINNATI #4S, #5, high power, M.D.
CINCINNATI #2 Dial Type, Timken Bearing, medium speed, Latest Type
KEARNEY & TRECKER #3K—Timken—latest
KEARNEY & TRECKER 2HL Timken, Latest
KEMPSMITH #4 Maximiller—Timken—latest

MILLING MACHINES—Univ.

AMES Bench, Timken Bearing, latest type, M.D.
BROWN & SHARPE #2A, AC, M.D.
HARDINGE Bench, Timken Bearing, Latest Type
VAN NORMAN 22L, Timken Bearing, Latest Type
VAN NORMAN #12, Timken Bearing, Latest

MILLING MACHINES—Vertical

BROWN & SHARPE #5—motor drive
CINCINNATI #2, Dial Type, Highspeed, Timken, Latest
CINCINNATI #3, #4 High-powered, Motor Drive
CINCINNATI #4, High Speed, Dial Type, Timken, Latest
KEARNEY & TRECKER 2K, 3H, 3K, Timken—latest
REED PRENTICE 3VG High-Speed, Latest Type

PLANERS

CHANDLER 36x36x20' 4 heads AC, M.D.
DETRICK & HARVEY 48x48x16', 4 heads, Hyd.
DETRICK & HARVEY 84x84x18', 4 heads, Box Table, DC, M.D.
GRAY 36x36x16', 3 heads, DC, M.D.
NILES 48x48x16', 2 heads, AC, M.D.
OHIO 42x42x20'—2 heads, AC
POND 48x48x16' 2 heads, AC, M.D.

SAWS

BRIDGEPORT #48W Abrasive
ESPEN LUCAS #138—Cold Saw, M.D.
GROB OS-20—band and filing—Latest Type
NEWTON #504, cap. 12½" Rd., M.D.
NEWTON #506, cap. 16¾" Rd., M.D.
NEWTON #508, cap. 22" Rd., M.D.

SHAPERS

CINCINNATI 24" Crank—Motor drive
CINCINNATI 26" Travel Head—2 head Type B
COCHRANE BLY Univ. Vert. Shaper-Miller, M.D.
LAMAIRE 18' Vert. Hydraulic—latest type
LYND FARQUHAR 28" Openside, Motor Drive
NILES 18" ver. slotter, DC, M.D.
MORTON 48" Draw-Cut, M.D.
MOREY 8", 10", 12", 14", Vertical Latest type
NEWTON 15" ver. slotter, D, M.D.
ORMEROD 8" Vertical, M.D.
PRATT & WHITNEY 6", 10" Vertical, Motor Drive

THREAD MILLING MACHINES

HALL—Planetary, M.D.—Latest Type
HANSON & WHITNEY 4x9, Latest Type
MOREY SHIELDS 12x120, 12x192—latest type
PRATT & WHITNEY 4½x12, Model "C"—Latest
PRATT & WHITNEY 6x14, Motor Drive
PRATT & WHITNEY 6x132—Motor Drive
PRATT & WHITNEY 6x20 Model "C"—Latest
SMALLEY General #20 MB, Motor Drive

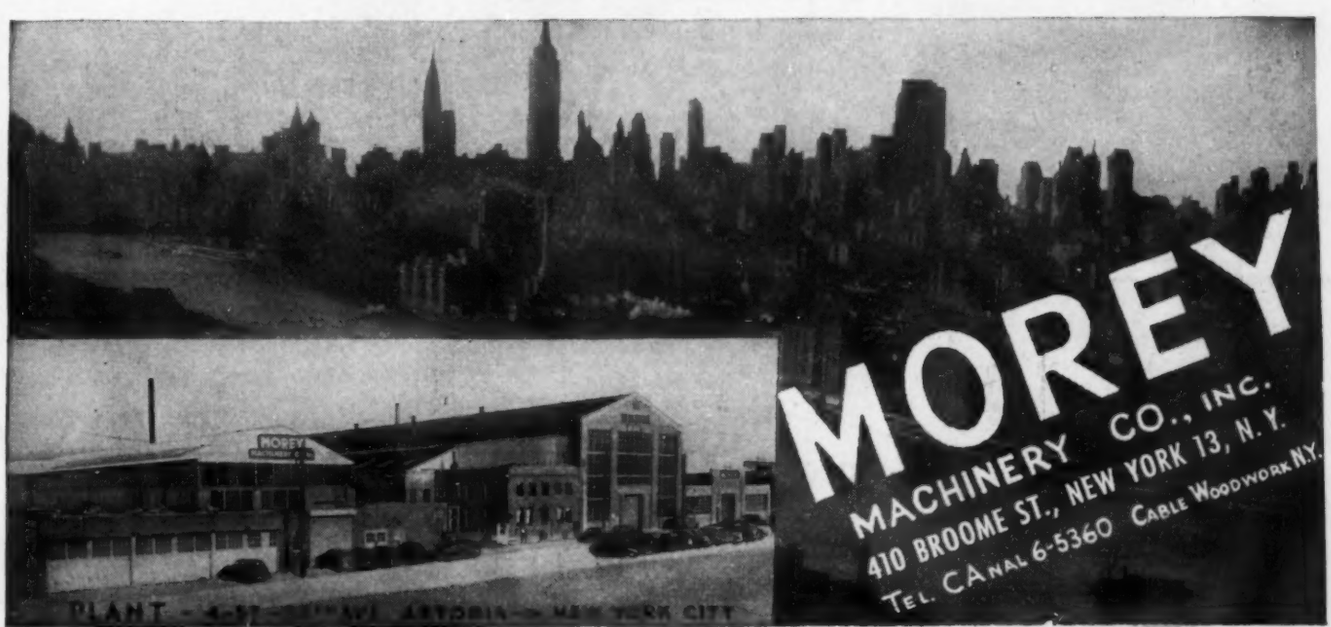
WOODWORKING MACHINES

YATES AMERICAN J-70, Latest
WYSONG & MILES #283-B Boring Machine, Latest Type
COVEL HANCHETT Model GK-32 Knife Grinder, Latest Type
DURRA JAMES 12" Tilting Arbor Saw Table

MISCELLANEOUS

BARNES #172 Vertical Hone, Hyd., Latest
BILLINGS & SPENCER 1500# Beard Drop Hammer
BARNES #420 2-spindle deep hole Drill—Hyd.—Latest Type
BARNES #249 Vertical Hone, Hyd., Latest
BAUSH Radial Tapper—latest
CASCADE #120 Industrial deep freeze
FERRACUTE No. DG55, Drawing, latest type
GENERAL ELECTRIC 100 KW Generator
LaPOINTE #3L Broach, horiz. hyd. 15 ton cap.
LeBLOND #2 deep hole borer, latest type
MORTON 60" combination travelling head planer, milling and drilling, motor drive.
NILES 30"x50' deep hole borer, Timken—latest
SLEEPER & HARTLEY #2 Universal Wire Nail Machine
SHUSTER #1 Wire Straightener
TREADWELL 12"—Pipe Threader—Motor Drive
WHITON 8x100 centers duplex centering, M.D.
YODER Multiple tube cutting machine—latest

Over 2,000 Machine Tools in Stock. Your Inquiries Are Invited



IN STOCK — IMMEDIATE DELIVERY

LATHES

12"x21" Fay Automatic (1942)
12"x18" Lipe Carbo, Motor Drive
18"x6' American Grd. Hd.
36"x30' Lodge & Shipley Triple Geared Selective Head, two carriages
42"x18' Putnam Geared Head
50"x17'cc LeBlond

MILLING MACHINES

No. 2K Milwaukee Plain (1941)
No. 4 Cincinnati Plain
No. 4 Cincinnati High Power Plain
No. 2H Milwaukee Vert. (1942)
No. 2 Cincinnati Vert. (1942)
No. 3 Standard Milwaukee Vert.
No. 3 Cincinnati Vert. Dial Type
No. 3K Milwaukee Vertical
No. 118 Van Norman Production, 18" Feed
24" Cincinnati Production
No. 27-MB Smalley-General Thread
No. 6 Lees-Bradner Thread
No. 2 Hanson-Whitney Thread
4" Taylor & Fenn Spline, M.D.
24"x24"x12' Ingersoll Adj. Rail
26"x25"x12' Ingersoll Adjustable Rail

DRILLS

No. 121 Baker, Motor Drive
No. D-8 Colburn No. 6 M. T.
No. 2 LMS—26"—1 Spdl. L-G (1944)
No. 2 LMS—20"—2 Spdl. L-G (1944)
No. 2 LMS—26"—2 Spdl. L-G (1945)
No. 2 LMS—20"—3 Spdl. L-G (1943)
No. 2—8 Spdl. Leland-Gifford
3'-11" Col. Morris (1943)
6'-15" Col. Cinn.-Bickford
6'-16" Col. American Triple Purpose
7'-15" Col. American Full Universal
7'-15" Col. Carlton, Motor on Arm
7'-17" Col. American Hole Wizard (1943)
8'-16" Col. American Triple Purpose

VERT. BOR. MILLS

34" King
42" Bullard New Era
72" Cincinnati
72" Niles Extra Heavy

HOR. BOR. MILLS

No. 31—3" Bar Lucas
3½" Bar Cinn.-Gilbert, Table Type (1942)
No. 25C, 3¾" Bar Defiance, Table Type (1942)
No. 360-F Giddings & Lewis (1942)
No. 560-F Giddings & Lewis (1942)

GEAR MACHINES

No. 3 Barber Colman (1943)
No. 7 Fellows Gear Shaper

PLANERS

28"x28"x6' Cincinnati
36"x36"x8' Woodward & Powell
36"x36"x12' Cincinnati, 4 Heads
42"x36"x12' Cincinnati

PRESS

2500 Ton Lake Erie hydraulic
No. 314 Bliss Squaring Shear

TURRET LATHES

No. 2 B. & S. Screw Machine, Wire Feed
No. 3 Jones & Lamson (1942)
No. 3 Warner & Swasey, bar feed (1940)
No. 1A Warner & Swasey, Preselector (1942)
18" Libby, 3½" H.S.

GRINDERS

10"x72" Colonial Broach Grd.
10"x24" Landis Universal
12"x36" Landis Univ. Type LCH (1945)
12"x48" Cincinnati Univ.
No. 22—12" Heald Rotary Surface
No. 34 Abrasive Surface
Norton Motor Driven Grinders, sizes 6x18 to 24x240

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HILL-CLARKE MACHINERY CO.

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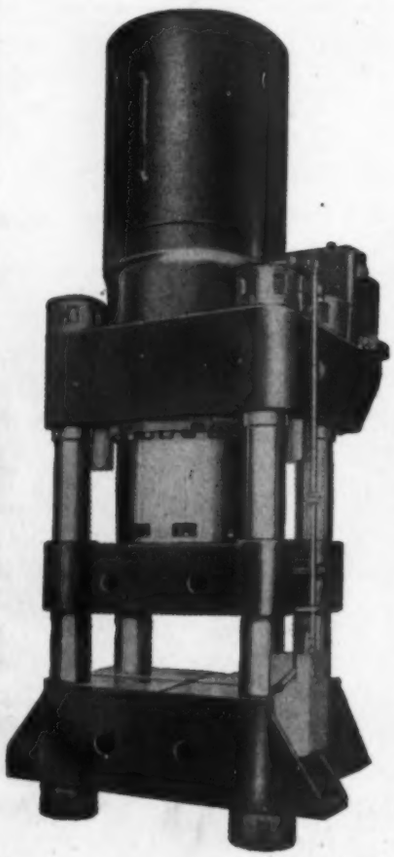

1300 TON WATSON STILLMAN HYDRAULIC PRESS Self Contained

Platen size 48"x42". Stroke 22". Opening 37. Ram Diameter 35". Driven by 50 H.P. Motor, *Also*

600 TON ELMES PRESS

Self contained 48x45" between rods, 36" stroke, 66" openings, 75 H.P. motor, 3 phase, 60 cycle, 220v.

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Aaron Machinery Co.

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MACHINE TOOLS

B4B NATCO "Holesteel" Drill 48-spindles

16" x 24" x 72" Mattison Surface Grinder

#18 Blanchard Vertical Surface Grinder, 36" Chuck

6" x 30" Norton Type "C" Plain Grinder

#2SL Lapointe Broach, Hydraulic, 32" stroke

#4K Kearney & Trecker H.S. Plain Miller

#3HS Cincinnati Vertical Miller

#3 and #4 Warner & Swasey Universal Turret Lathes

#1 Brown & Sharpe Wire Feed Screw Machines

ALL LATEST TYPE MACHINES

HAZARD BROWNELL

350 Waterman St., Providence 6, R.I.
Dexter 8880

POWER PRESSES

BLISS, TOLEDO, V & O, ETC. REBUILT — GUARANTEED

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Tioga, Livingston and Almond Streets, Philadelphia, Pa.

THE LARGEST MACHINE TOOL PLANT IN THE U.S.A.

Eastern OFFERS FROM STOCK

DEVOTED EXCLUSIVELY TO REBUILT MACHINERY

ENGINE LATHES

12"x6' bed Lodge & Shipley Selec. Head, m.d. in leg, taper, relieving
12"x84" centers Lodge & Shipley Selec. Head, m.d., taper
13"x30" centers Pratt & Whitney type B, m.d. in leg, taper
13"x48" ecnters Pratt & Whitney as above
14"x6' American Geared Head, m.d., taper
14"x6' Hendey Geared Head, m.d., taper
14"x6' Pratt & Whitney, cone
14"x6' Springfield Geared Head, m.d. in leg, taper
14"x8' Pratt & Whitney, cone
16"x6' Bradford, cone, taper
16"x6' Hendey Geared Head, m.d.
16"x6' Lodge & Shipley Selec. Head, m.d.
16"x30" centers Monarch Geared Head, m.d. in base
16"x54" centers Monarch Geared Head, m.d. in base, taper
16"x60" centers Lodge & Shipley Selec. Head, m.d. in leg, taper
16"x8'6" centers Monarch Geared Head, m.d. in leg, taper
18"x7' Hendey Geared Head, m.d., taper
18"x8' American Geared Head, m.d., taper
18"x8' Champion, cone
18"x8' Greaves-Klusman, cone, taper
18"x8' Hendey Geared Head, m.d., taper
18"x8' Lodge & Shipley, cone
18"x8' Whitcomb-Blaisdell Geared Head
19"x10' LeBlond Geared Head, m.d.
20"x48" centers Monarch Geared Head, m.d. in leg
20"x48" centers Reed-Prentice Geared Head, m.d. in leg, taper
20"x6' centers Monarch Geared Head, m.d. in leg
20"x8' Cisco, cone
20"x8' Springfield Geared Head, taper
22"x70" centers Greaves-Klusman Geared Head, m.d., taper
22"x8' Lodge & Shipley, cone
23"x12' LeBlond Geared Head, m.d., taper
24"x10' American, cone, taper
24"x10' Greaves-Klusman Geared Head, m.d., taper
24"x10' Hendey Geared Head, m.d.
24"x10' Lodge & Shipley, cone
24"x12' LeBlond, cone
24"x12' Reed-Prentice Geared Head, m.d., taper
24"x14' Boye & Emmes, cone, taper
24"x20' Lodge & Shipley, cone, taper
25"x10' LeBlond, cone
30"x26' Lodge & Shipley Selec. Head, m.d.
36"x21' centers Putnam Geared Head, m.d.
36"x28'6" centers Niles H.D. Geared Head, m.d., latest
36"x30' Lodge & Shipley Selec. Head, m.d.
36"x32' centers Putnam Geared Head, m.d.
36"x36'6" Niles H.D. Geared Head, m.d., latest
50"x204" centers LeBlond H.D. Geared Head, m.d., taper, p.r.t., latest type
20"x8' centers Lodge & Shipley Selec. Head, m.d.
24"x9' centers American Geared Head, m.d.

AUTOMATICS

No. 4D Potter & Johnston, m.d., latest
No. 5D Potter & Johnston, m.d., latest
4 spindle 7/8" Cleveland Model M, m.d.
4 spindle 2" Cleveland Model M, m.d.
2¼", 2½", 4¼", 5½", 6", 7¾" Cleveland Model A, m.d.
2¼" Gridley S.S., m.d.
4 spindle 2¼" Cleveland Model K, m.d.
No. 6A Potter & Johnston, m.d.
No. 6C Potter & Johnston, m.d.
14" Fay, Flanders Type, m.d.
20x25" Jones & Lamson, m.d., latest

HORIZONTAL BORING MILLS

No. 21 Lucas, 2½" bar, m.d.
No. 31 Lucas, 3" bar, m.d.
No. 32 Lucas, 3½" bar, m.d.
No. 33 Lucas, 4½" bar, m.d.
2½" bar Cleveland, m.d.
4" bar Detrick & Harvey Floor Type, m.d.
4" bar Landis Floor Type, m.d.
4" bar Niles, m.d.
4½" bar Niles, m.d.
5½" bar Niles, m.d.
6" bar Niles-Bement-Pond Floor Type, m.d.
10" bar Sellers Floor Type, m.d.
Morton 60" stroke Boring Mill and Draw-Cut Traveling Head Planer, m.d.

VERTICAL BORING MILLS

24" Bullard New Era, m.d., with side head
24" Bullard Spiral Drive, m.d., with side head
36" Bullard New Era, m.d., with side head
36" Bullard Spiral Drive, m.d., with side head
42" Colburn H.D., m.d., 2 rail heads
42" Bullard Spiral Drive, m.d., with side head, latest type
48" Cincinnati Rapid Production, 1 turret, 1 swivel head, m.d.
48" Colburn, 1 turret, 1 swivel head, m.d.
48" Putnam H.D., m.d., 2 swivel heads
52" King, m.d., 2 swivel heads, latest type
53" Niles, m.d., 2 swivel heads
54" Colburn, m.d., 1 turret, 1 swivel head
72" Cincinnati, m.d., 2 swivel heads
84" Niles, m.d., 2 swivel heads
100" Niles Heavy Pattern, m.d., 2 swivel heads

MANUFACTURING LATHES

No. 9 Heavy LeBlond Multi-Cut, m.d.
3½x36", 3½x80" LoSwing, s.p.d.
4x60" LoSwing, m.d., latest type
8x84" LoSwing, m.d.
8x132" LoSwing, m.d., latest type
9x12" Sundstrand Mfg., s.p.d.
9x14" Porter-Cable Mfg., m.d.
13x24" Coulter Automatic Threading, m.d.
13x96" Coulter Automatic Threading, belt
16"x6' Cincinnati Mfg. m.d. in base
16"x6' LeBlond Rapid Production, m.d. in base
17"x8' LeBlond Auto Mfg.
17x124" centers LeBlond Rapid Production Geared Head, m.d., latest
No. 4 LeBlond Boring Lathe, 37' bed, 14'4" boring length, 13" hole thru spindle, m.d., latest type
Niles-Bement-Pond Quartering Machine, m.d., new

PLAIN MILLING MACHINES

No. 000 Brown & Sharpe, m.d., latest
No. 1B LeBlond, cone
No. 1M Cincinnati, m.d.
No. 1A Milwaukee, m.d.
No 1½, 2 Cincinnati, cone
No. 2B Brown & Sharpe, m.d. in base, latest
No. 2 Cincinnati H.S. Dial, m.d, latest
No 2L Cincinnati, m.d. in base, Timken
No. 2MH Cincinnati, m.d. in base
No. 3B Brown & Sharpe, m.d. in base, latest
No 3S Cincinnati, s.p.d.
No. 3 Kempsmith, cone
No. 4B Brown & Sharpe, m.d.
No. 4 Cincinnati H.P., m.d.
No. 4 Cincinnati H.S. Dial, m.d., latest
No 5B Heavy Brown & Sharpe Plain, s.p.d.
No. 5 Cincinnati H.P., rect. overarm
No. 5 Cincinnati H.P., Timken, rect. overarm, latest
No. 5 H.D. LeBlond, s.p.d.

UNIVERSAL MILLING MACHINES

No. 2 H.D. LeBlond, cone
No. 3S Cincinnati, m.d.
No. 4A Brown & Sharpe, m.d.
No. 4G LeBlond H.D. s.p.d.

VERTICAL MILLING MACHINES

No. 2, 3, 4 Cincinnati H.S. Dial Type, m.d., latest
No. 2, 3, 4 Cincinnati M.S. Dial Type, latest
Cincinnati Hydromatic, with 2 vertical spindles on rail
No. 2, 3, 4 Cincinnati H.P., m.d.
No. 2H, 3H, 4H Milwaukee, m.d., latest
No. 2K, 3K, 4K Milwaukee, m.d., latest
No. 2½, 3B, 4 Milwaukee, m.d.
No. 3V Van Norman, m.d., latest
No. 5 Brown & Sharpe, cone
No. 5 Jackson, m.d.
No. 5 Reed-Prentice, m.d., latest type
No. 6 Becker, cone
No. 28-60 Cincinnati 2 spindle Hydro-Tel, m.d., latest

MANUFACTURING MILLING MACHINES

Type P Ohio, m.d.
Sundstrand Rigidmill, m.d.
No. 00 Sundstrand Hydr. Rigidmill, m.d., latest
No. 0-8 Cincinnati Model EA Plain Auto., m.d., latest
No. 1-12 Cincinnati Plain Auto., m.d
No 1-18 Cincinnati Plain Auto., m.d., latest
No. 2-24 Cincinnati Plain Auto., m.d., with rise and fall, latest
No. 3A Sundstrand Copy Rigidmill, m.d.
No. 3-24 Cincinnati Plain Hydromatic, m.d., latest
No. 34-36 Cincinnati Duplex Hydromatic, m.d., latest, tracer control, latest
No 3-36 Cincinnati Duplex Hydromatic, m.d.
No. 4-48 Cincinnati Plain Hydromatic, m.d., latest
18", 24" Cincinnati Plain Automatic, m.d.,
24" and 48" Cincinnati Duplex Automatic, m.d.
No. CT-36 and CT-54 Lees-Bradner Thread, m.d., latest
Hall Planetary Thread, m.d.
4" Pratt & Whitney Spline, m.d.
4½x12", 6x14", 6x20", 6x48", 6x80" Pratt & Whitney Thread
10x24" Hansen-Whitney Thread, m.d.
30"x30"x12' Ingersoll Slab, m.d.
36"x24"x8' Ingersoll, 1 rail, 2 side heads, m.d.
108"x72"x26' Gray Double Housing Milling Planer, m.d., 2 planer heads on rail, 2 side heads, one removable milling head on cross rail

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MORE THAN 2,000 MACHINES IN STOCK

THE EASTERN MACHINERY COMPANY
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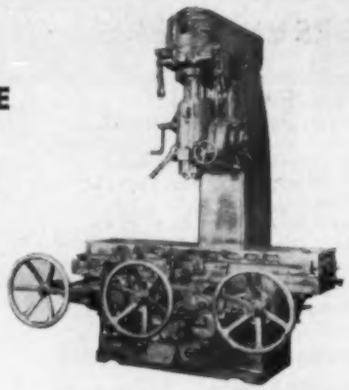
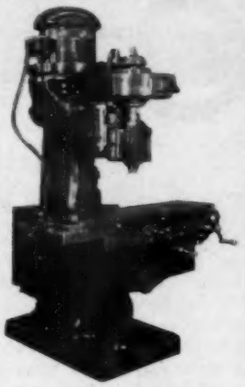
MElrose 1241
CABLE ADDRESS EMCO

EMERMAN

NO. 5
REED-PRENTICE
VERTICAL
JIG MILLING
MACHINE,
table 68" x 16",
motor drive



NO. 3 VG
REED-PRENTICE
VERTICAL
MILLING
MACHINE and
DIE SINKER
table
44" x 10½"
motor
drive



ALL SIZES UNIVERSAL & PLAIN MILLS

VERTICAL MILLS

No. 08 Cincinnati
No. 1 Brown & Sharpe
No. 2 Cincinnati
No. 2½B Milwaukee
No. 3 Cincinnati
No. 3 Brown & Sharpe
No. 4 Cincinnati
No. 4 Kempsmith
No. 4K Milwaukee
No. 5 Becker
No. 6 Becker

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All Very Late Type—

1—#25A 24" Heald Rotary Surface Grinder
1—#2K Kearney & Trecker Vertical Miller, dial type
1—#4H Kearney & Trecker Vertical Miller, dial type
2—6"x18" Norton type "C" Cylindrical Grinders
1—16"x72" Norton type "C" Cylindrical Grinders, never used.
1—16"x72" Landis type "D" Cylindrical Grinder, used 4 months.
1—#5-60 Cincinnati Hydromatic Duplex Miller with rise and fall attachment, never used.
1—#21 Reed Thread Roller with lot of dies and equipment.
1—#5 Abrasive Surface Grinder, cap. 14x 10x48".
2—#0-8 Cincinnati Vertical and Horizontal Millers.
2—#262 Barnes 2-spindle drills, 26"—2" cap. in steel.
3—#3 Bardons & Oliver 1½" bar feed Universal Turret Lathes.
1—#EG54 Ferracute 400-ton Knuckle Joint Power Press.
1—#72A3 Heald Internal Grinder.
2—#6A Marvel Power Hack Saws.

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NEW YODER POWER HAMMER AT BARGAIN PRICE

Model K-90-M Pedestal Type with large quantity of new dies.

THIS MACHINE HAS NEVER BEEN USED

NET PRICE.....$1,250.00
COMPLETE WITH MOTOR AND DIES

IMMEDIATE SHIPMENT FROM STOCK

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LATE TYPE TOOLS

#2MH Cinci. Univ. Miller 1944
#3SP Van Norman Miller 1942
Nos. 2, 3, 4, Cinci. Vert. Miller '42, '45
#2, 3, 4 & 5 W. & S. Univ. &
#3 J. & L. Univ. Turret Lathes
#712 Fellows Gear Generator, 1942
36H & 48H G.&E. Gear Hobbers
30" x 15' centers Amer. Super Pro. Lathe
18" raised to 24½" x 192" centers, BB Model Monarch, Carr. P. R. T., '42

BENNETT MACHINERY CO.
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IMMEDIATE DELIVERY FROM STOCK

No. 4½ BLISS, 80-100 Ton Capacity straight side punch press, late model with scrap cutters, double roll feeds, bolster. 10 H.P. motors and controls, forced feed lubrication. 21x27 bolster 4½" stroke. In both Single and Double Action Models. Like new. 110 strokes per minute.

No. 6 BLISS 90-125 Ton Capacity, straight side Punch Presses, late model. With scrap cutters, double roll feeds, bolster, 15 Hp motors and controls, forced feed lubrication. 25x30" bolster, 5½" stroke. In both Single and Double Action Models. Like new. 88 strokes per minute.

35 ton Bliss Gap Frame Punch Presses, 4-8" stroke, latest design.

1—#87 BLISS Press, 175 Ton cap. 32" stroke, late model.

(2) 100 ton Henry & Wright Dicing Press, latest design.

SPOT WELDERS IMMEDIATE DELIVERY 5-300 KVA, Brand new. Guaranteed.

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36"x36"x12' Gray, 2 heads
42"x42"x10' Detrick & Harvey Open Side, 3 heads.
Older type machines in good condition.

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FOR SALE—OPENSIDE PLANER

One used Cleveland Openside Planer 48"x48"x 10' with 3 heads and 440 volt 3 phase, 60 cycle motor drive. Can show in operation.

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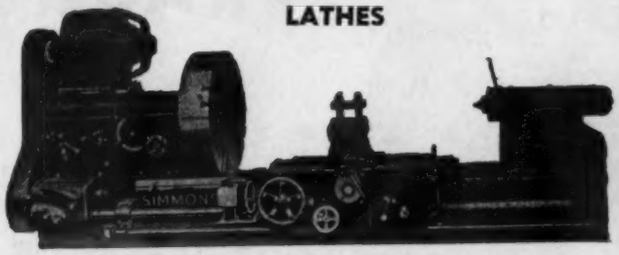
SIMMONS CURRENT HEAVY TOOLS

BORING MILLS

9" Bar BETTS Horizontal floor type, 50" face plate 6'—vertical travel, modern, 4-motors.
3" Bar Universal TRI-WAY Horizontal, P.R.T.
4½" Bar N.B.P. Table type.
No. 35 LANDIS, Floor Type
24" New Era, BULLARD
54", 60" and 72" COLBURNS, two heads.
12' BETTS Extra Heavy double drive
14' BETTS, Heavy, late type
16-24' NILES-BEMENT-POND, Extension Type, two swivel heads. AC or DC.
16' NBP 2 swivel heads.

27" #2H-8 LIBBY Heavy Turret Lathe, Hardened Steel Ways 20 H.P. 60-3-220/440

LATHES



48"x40' SIMMONS Heavy Geared Head Engine Lathe, AC or DC (new 1942)

24"x13' AMERICAN 12-speed, G.H.
25"x10' LEBLOND G.H.
27"x22' REED PRENTICE G.H.
30"x18' AMERICAN 12-speed, G.H.
30"x23' AMERICAN 12-speed, G.H.
36"x40' AMERICAN 16-speed geared head.
42"x34' LEBLOND late type, 27-speed, G.H.
48"x40' SIMMONS, Geared head.
48"x45' NILES, 16-speed, G.H.
60"x27' NILES, 24-speed, G.H.
90" PUTNAM Driving Wheel Lathe with journal truing.
3-AL GISHOLT, Hardened Ways.

Write today for Complete Current Stock List of Simmons Engineered Rebuilt Machine Tools

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Bertsch Rolls—20' x ⅜" Cap. Initial Type—Open End —35 HP

BRAKES—(Power) New Press Brakes—Lynn Hydraulic 56" x 14G
D & K 5' x 10G Box & Pan 13 Fingers
D & K 8' x 16G Apron

SHEARS—(Power) New—Pexto 6' x 16 G, Gap

LATHES—Monarch 18" x 10' over-all geared head motor in base
South Bend (Floor) 9" x 3' motor in base

GRINDERS—Crankshaft Landis 16" x 48"

PRESSES—(5) V & O #0 Dial Feeds OBI
(2) V & O #01W (1 Roller Feed) OBI
(2) Bliss #18, OBI
(22) Hercules 22 Ton Dial & Hopper Feeds, SS
(11) Wat-Far 25 Ton Dial Feeds, SS
Styles-Parker 75 Ton, OBI
Bethlehem 88 Ton, SS
(2) Bliss #52, 45 Ton, SS
Toledo #54, 60 Ton, SS, with side shear
Bliss #856, Rack & Pinion, 88 Ton

EYELET PRESS, Wat-Farrel 50 Ton, 6 Plunger

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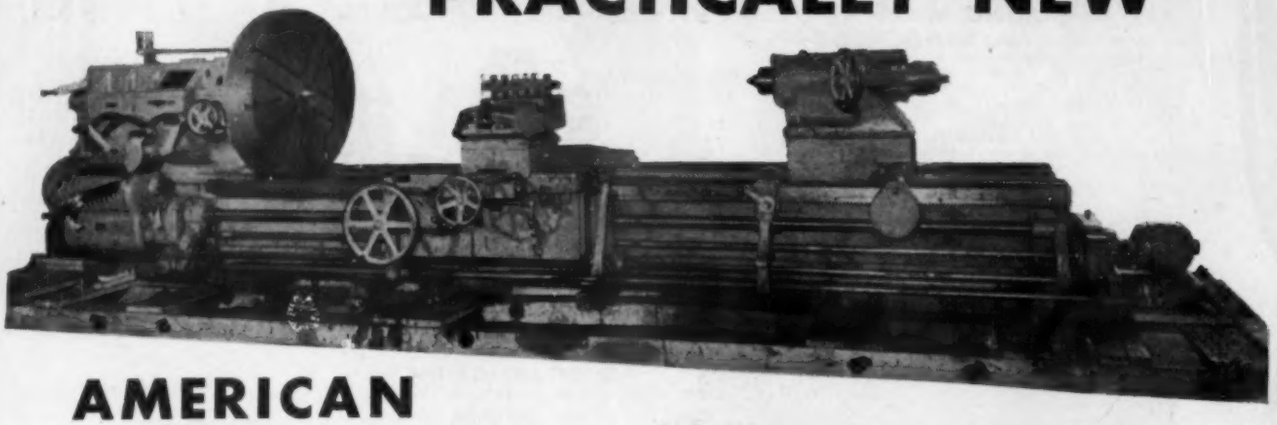

AMERICAN
HEAVY DUTY ENGINE LATHE

48" x 22" GEARED HEAD ACTUAL SWING 50½"
DISTANCE BETWEEN CENTERS 156" Serial No. 64446-42
LESS THAN TWO YEARS ACTUAL SERVICE
CONDITION EQUAL TO NEW . . . PRICE $12,500.00

INSPECTION MADE AT OUR WAREHOUSE

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Spur Gear Hand HOISTS

We added a hook to a surplus bomb hoist to make this brand new piece of factory and machine shop equipment.

Ideal for all kinds of stationary lifting . . . over lathes, grinders and work benches. Uses are many in motor repair shops and boat yards.

Aluminum housing, steel gears, bronze bushed. 20 ft. of wire rope, multi-strand, complete with hook. Ball operating chain with easy release. Simple to install on beam or girder.

Hoists are unused, clean and guaranteed to be mechanically perfect. Lifting range from 300 to 500 pounds. Gear ratio: 5 to 1.

Price: $10 each
Postpaid in U. S. A.

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14"x6' AMERICAN 12-speed Grd. Hd. Lathe, AC MD, taper
14"x6' HENDEY Toolroom Lathe, Schulte Drive, univ. relieving attachment
15"x10' LEBLOND H.D. Lathe, 4-speed A.C. mtr. in leg
16"x12' LODGE & SHIPLEY Selec. Grd. Hd. Lathe, AC MD, taper
18"x10' LODGE & SHIPLEY Selec. Grd. Hd. Lathe, AC MD
20"x8' LODGE & SHIPLEY Selec. Grd. Hd. Lathe, AC MD
24"x12' LODGE & SHIPLEY Selec. Grd. Hd. Lathe, AC MD, taper

#2 MILWAUKEE Univ. Miller, SPD, DOA, Timken, PRT, Div. Hds.
#3 CINCINNATI Univ. Miller, AC MD, Div. Hds., Vert. Attach., Slotting Attach.
#42 OHIO Plain Miller, Lima Drive, PRT
#4B MILWAUKEE Plain Miller, arr. MD, DOA, PRT

16", 20", 24" & 28" GOULD & EBERHARDT H.D. Shapers, AC MD

#25A HEALD Rotary Surf. Grinder, AC MD
#72A2 HEALD "Sizematic" Internal Grinders, AC MD
#2 BROWN & SHARPE Univ. Grinder, arr. AC MD
#51 & #510 OLIVER Drill Grinders, AC MD

24" & 36" BULLARD "New Era" Vertical Turret Lathes, AC MD
72" COLBURN Vert. Boring Mill, PRT, arr. AC MD

#3 & #12 BARBER-COLMAN Gear Hobbers, AC MD
EL-6 FERRACUTE OBI Press, AC MD, 93 tons
#1 & #2 DAVIS Keyseaters

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P.O. Box 1953 — Cincinnati 1, Ohio
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LANDIS PL. CYL. GRINDER—TYPE C
6"x18". Serial 24427. Complete with 220/440 volt motors and extra live spindle headstock. Machine new May 1945.

R-S GAS FIRED SALT POT FURNACE
30" dia. by 40" deep. Serial 44196. Complete with pot-ring, air-ejector, controls, Nichrome salt pot. Never used.

LANGELIER L-11 SWAGING MACHINE
6½" capacity. 50 H.P. 220/440 volt. New July 1945.

TOCCO JR. INDUCTION HEATING MACHINE
15 KW, Single station, 25 H.P. 220/440 volt. New November 1944.

Plant Engineer
WALTER KIDDE & COMPANY, INC.
Belleville 9 — New Jersey

DAVENPORT
5 Spindle Automatic Screw
FOR SALE

Sp. Stop. Att., New West. Motor & Controls, Oil Guards, Gears, Cams, etc. Serial #567.

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12"x5' Hendey Lathe, M.D.
14"x5' Hendey Lathe, M.D.
No. 2 B & S Surface Grinders

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Bolt Cutter, 1"-1½"-2"-2½"-4" Acme, Landis.
Boring Mills, 24"-36"-42"-52"-72"-96".
Drills, Radial 6' Cin.-Bick. 5' Carlton.
Lathe, Turret 3-A W. & S., S. P. D.
Millers, Plain No. 3 K & T. No. 4 Cin.
Millers, Vertical No. 3 B & S & No. 4 Cin.
Profiler, #13 P. & W., B.D.
Shapers, 16"-20"-24"-36".
Shaper, 36" Morton Draw Cut.

West Penn Machinery Company
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WIRE STRAIGHTENING & CUT-OFF MACHINE

¼" Capacity Schuster with 16 ft. Cut-Off, including jack-shaft.
⅝" Schuster, Model ADT, with 32 ft. cut-off, including jack-shaft.

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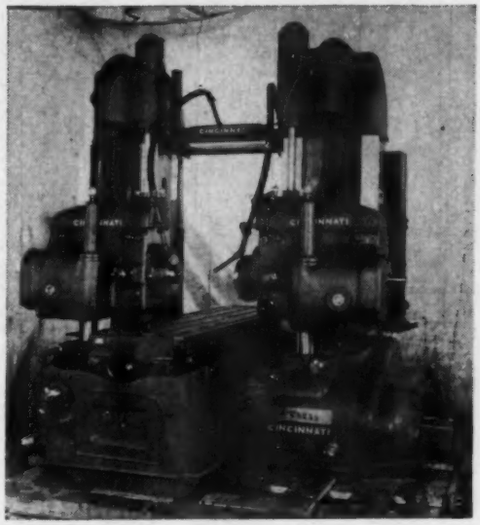
36" BULLARD Vert., M.D.
42" BULLARD Vert., M.D.
3½" bar GILBERT Table Type Horiz., M.D.
#25-C DEFIANCE Table Type, M.D.
#360-F GIDDINGS & LEWIS, Floor Type, M.D.
#560-F GIDDINGS & LEWIS, Floor Type, M.D.

GRINDERS

#10 B & S Tool & Cutter, M.D.
#72A3 HEALD Plain & Sizematic, M.D.
#4T SELLERS Tool Grinder, M.D.
9" P & W Hyd. Gear Grinder, M.D.
#5 B & S Plain Grinder, M.D.
10"x72" HILL-CLARKE (Norton) Grinder, M.D.
14"x168" NORTON Type "C" Plain, M.D.
#11 BLANCHARD Rotary, 16"x20" chucks.
30"x24"x16' MATTISON Surface Grdr., M.D.

LATHES

12"x30" LODGE & SHIPLEY G.H. Lathe, M.D.
14"x30" LODGE & SHIPLEY G.H. Lathe, M.D.
12"x30" MONARCH Model "C" Lathe, M.D.
32"x324" centers LEBLOND LATHE, T.A., M.D.
42"x61' centers AMERICAN "SUPER PRODUCTIVE," M.D.
50"x17' centers LEBLOND "BIG SWING" Lathe, M.D.



#5/60 CINCINNATI, Duplex Hydromatic Milling Machines, tracer control mechanism for automatic rise & fall of spindle carriers, M.D., one machine used six months—one new—never used.

MILLING MACHINES

#2MS CINCINNATI Dial Type, Plain, M.D.
#4MS CINCINNATI Dial Type, Plain, M.D.
#3MS CINCINNATI Dial Type, Vert., M.D.
#3HS CINCINNATI Dial Type, Vert., M.D.
#3K KEARNEY & TRECKER Vert., M.D.
#4 CINCINNATI "HI-POWER" Vert., M.D.
#5H KEARNEY & TRECKER Plain, M.D.
#1H-12 KEARNEY & TRECKER MFG., M.D.
#M-50A TAYLOR & FENN Vert., M.D.
#12-M MOREY 2-spdle PROFILER, M.D.

RADIAL DRILLS

3'11" AMERICAN "HOLE WIZARD," M.D.
6'17" FOSDICK "ECONOMAX" M.D.
7'17" AMERICAN "HOLE WIZARD," M.D.

TURRET LATHES

#0 B & S Wire Feed Screw Machines, M.D.
#2 W & S Ram Type Univ., M.D.
#3 W & S Ram Type Univ., M.D.
#4 W & S Ram Type Univ., M.D.
#3 J & L Ram Type Univ., M.D.
#1A W & S Saddle Type Univ., M.D.
#2A W & S Sadle Type Univ., M.D.
#3A W & S Saddle Type Univ., M.D.

MISCELLANEOUS

32" OHIO Heavy Duty Shaper, M.D. (1942)
6"x48" THOMPSON Broach Grinder.
#36BM GOULD & EBERHARDT 3-spdle Gear Rougher
#4½ BLISS S.S. Double Action Press, M.D.
3/16"x96" CHICAGO Power Squaring Shear, M.D. (1942).

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203 BENT STREET — **WAA Approved Dealer Box. #1** — **CAMBRIDGE, MASS.**

LATEST DESIGN

62" KING MILL

1—62" KING (66" Swing) New Type Heavy Duty Vertical Boring and Turning Mill equipped with two rail heads (R. H. side has swiveling turret type rail head) and one side head. Powered by 30 HP 230 volt D.C. motor to provide variable table speeds from 1.75 to 55.4 RPM. *Excellent condition, manufactured in 1942.*

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AUTOMATIC, 3½" Cone 4-Spindle (5)
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BOLT CUTTERS, No. 22 Murchey, Dble. Hd.
BOR. MILLS, 2½" bar, Cleveland, M.D.
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BORING MILL, 30" Bullard, "New Era".
BORING MILL, 40" King, 2 heads, M.D.
BROACH, Hr. Hyd. XA Oilgear, 60" stroke.
BROACH, Vert. Hyd. SRV5-42" LaPointe.
DRILL, Hvy. Duty, No. 515 Baker, No. 6 M.T.
DRILL, Radial 6' Cinc.-Bickford, M.D.
GEAR SHAPER, #75 Fellows, M.D.
GRINDER, Internal, No. 72A5 Heald, 2 Mtr.
GRINDER, Plain, 14"x72" Norton
GRINDER, Plain, 24"x240" Norton, M.D.
GRINDER, Surface, No. 5 Abrasive, 14"x48".
GRINDER, Surf. Hyd. G & L, 14"x18"x72"
GRINDER, Surface, No. 25 Heald Rotary
HAMMER, Board Drop, 1,000#, B. & S.
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LATHE, 24"x16' B & E Grd. Hd.
LATHE, 27"x18' Niles "Timesaver," Grd. Hd.
LATHE, 36"x22' N-B-P, Grd. Hd., Q.C.G.
LATHE, 38"x19' Putnam, Grd. Hd. Q.C.G., T.A.
LATHE, 42"x50' Putnam, Grd. Hd.
MILLER, Duplex 24" Cincinnati, Auto.
MILLER, Plain, No. 3B Milwaukee, S.P.D.
MILLER, Plain, Nos. 3S, 4 & 5 Cincinnati.
MULT-AU-MATICS, Bullard, Type A, 6-Spdle.,
PLANER, Openside, 36"x36"x12' Cleveland
SHAPER, 32" Gould & Eberhardt, M.D.

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Bent Tail

¼", $.50 each

½", ¾", $.75 each

1", 1½", 1¾", 2", $1 each

2½", 3", 3½", 4" $1.00 each

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CAnal 6-5575

THREAD GAGES—PLUG AND RING

Slightly used, NF-2 & 3, ¼ to 1", 6, 8, 10 M.S. Also 1 to 4" N.S.
LESS 75 Percent Discount.

ADJUSTABLE SNAP GAGES. ALL SIZES. ½ to 8".
LESS 75 Percent Discount.

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ENGINE LATHE

20"x72" centers American Pacemaker. Taper attachment, collets, 2 chucks, pan & pump. Built 1946.

BORING MILL

4¾" bar, No. 300 Giddings & Lewis, floor type Vertical travel 82", horizontal travel 132", feed of bar 40" Has outer support and bed plate.

PLANER

96"x48"x12' Liberty with 2 rail and 1 side head. Has power rapid traverse, forced feed lubrication and variable voltage drive with MG set.

BROACH

No. HP50 Lapointe hydraulic with extension broach support. 25 ton capacity, 72" stroke. Built in 1940.

RADIAL DRILL

4', 9" column Cincinnati Bickford Super Service with box table. New 1946.

SENSITIVE DRILL

24" Allen 3 spindle No. 3 type VCPF with power feeds and back gears. New 1942.

TAPER SPLINE HOBBER

Type T Barber Colman wth long overarm with support at rear for long work. For splines or gears. New 1942 or 1943.

CENTERLESS GRINDERS

Nos. 2 & 3 Cincinnati with Filmatic bearings, hydraulic profile truing. Built from 1940 to 1943.

CYLINDRICAL GRINDERS

6"x18" No. 10 Brown & Sharpe electric-hydraulic. Three have oscillating attachment.
New in 1941 and 1942.

CYLINDRICAL GRINDER

10"x72" Norton type C hydraulic with lot of equipment. New in 1942.

SURFACE GRINDERS

10"x24" Norton hydraulic. New in 1942.

TURRET LATHES

Nos. 2, 4 & 5 Warner & Swasey universal. Late type with bar feed or chuck. Built from 1940 to 1944.

PLAIN MILLERS

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Gisholt No. 1L, 2L Univ. M.D.
Foster Nos. 4, 5, 6, 1B, 3B M.D. Univ.
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Acme #2 M.D.

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#25A Heald, M.D.
No. 2 Cincinnati Centerless M.D.
B. & S. No. 2, 2B Surface, M.D.
P. & W. 14", B.B., Vert. M.D.
Blanchard 30", M.D.; Modern 12x48" M.D.
Norton Hydraulic 12x18", M.D.
Heald Nos. 72A3 Gagematic
Norton 50"x28', M.D.
Landis Type A 6x20" Hydraulic, M.D.
No. 55, 60, 65 Heald int., M.D.
12" Heald Rotary Arter 12" M.D.
B. & S. No. 10 11 Cyl. #5.
B. & S. No. 1, 3 Universal
Grenby 1-2 Int.
Norton 6x18" Hyd. Surface, M.D.

LATHES

10"x3' South Bend, M.D. Late.
Monarch, Hendey 12x30 geared head, Late
26x12' Boye & Emmes 3 step cone B.D.G.
14"x6' Hendey
9" LeBlond, P&W Auto.
36x30' Putnam M.D.
36x22' Putnam, D.C. M.D.
32"x35' Wickes, M.D.
Putnam 42x16', M.D. S.C.G.
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LeBlond "Regal" 16"x12', 17"x12' Grd. Hd., M.D.

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Bridgeport Vert., M.D.
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#12, #22L Van Norman Univ.
#2B K & T Univ.; No. 2-2A B & S Univ.
No. 2 Cincinnati Univ.
#2HL Milwaukee, M.D. late
No. 3S Cincinnati, S.P.D. rapid trav.
Nos. 0Y, 2, 3, 4, 5 B & S Plain & Univ.
Hall Planetary Model D Thread Miller
Becker Nos. 3, AB, 5, 6, Vert.
Nos. 2, 3, 4 Cincinnati Vert.
P. & W. No. 12, 30" Profiler, M.D.
K. & T., B. & S., No. 2, 3
B. & S. No. 1, 3, Vert.
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24" Lel-Gif. 2LMS—BXO Column—1942
24" Cin.-Bickford—Upright—Bx. Col.—1942
16" Can.-Otto Floor & Bench—110/1/60—NEW
21" Can.-Otto Upright —BG—M.D.—NEW

GRINDERS

6x18 Reid #2C Hand Feed—Mtr. Spdle—1942
#13 Brown & Sharpe Universal—Tool & Cutter—1942

LATHES & TURRETS

16"x6' Sebastian—8 speed—G.H.—NEW
16/20x58" Lodge & Shipley—Sel. Hd.—24 sp.—1942

SAWS

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#2MH Cinc.—Plain Horiz.—PRT—1942 Mfg.
#3 Cinc.—Plain Horiz.—PRT—1942 Mfg.
#2K K&T—Vertical—PRT—1942 Mfg.
#5H K&T Vert.—1942 Mfg.
U. S. Multi-Miller—Mtr. Dr.

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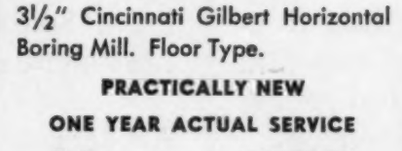

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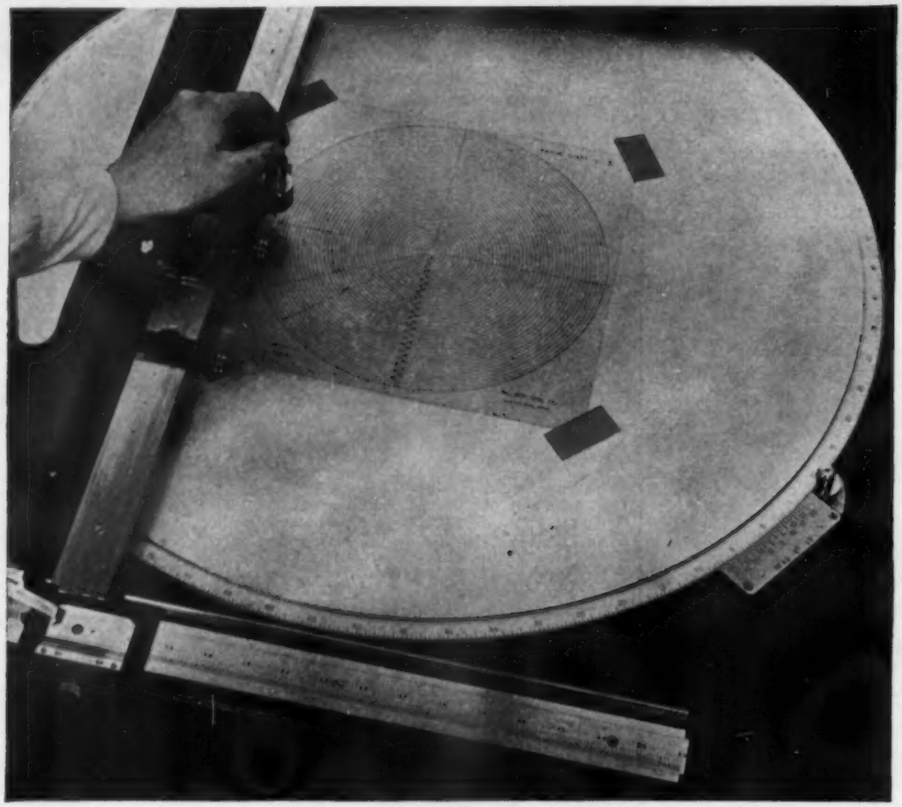

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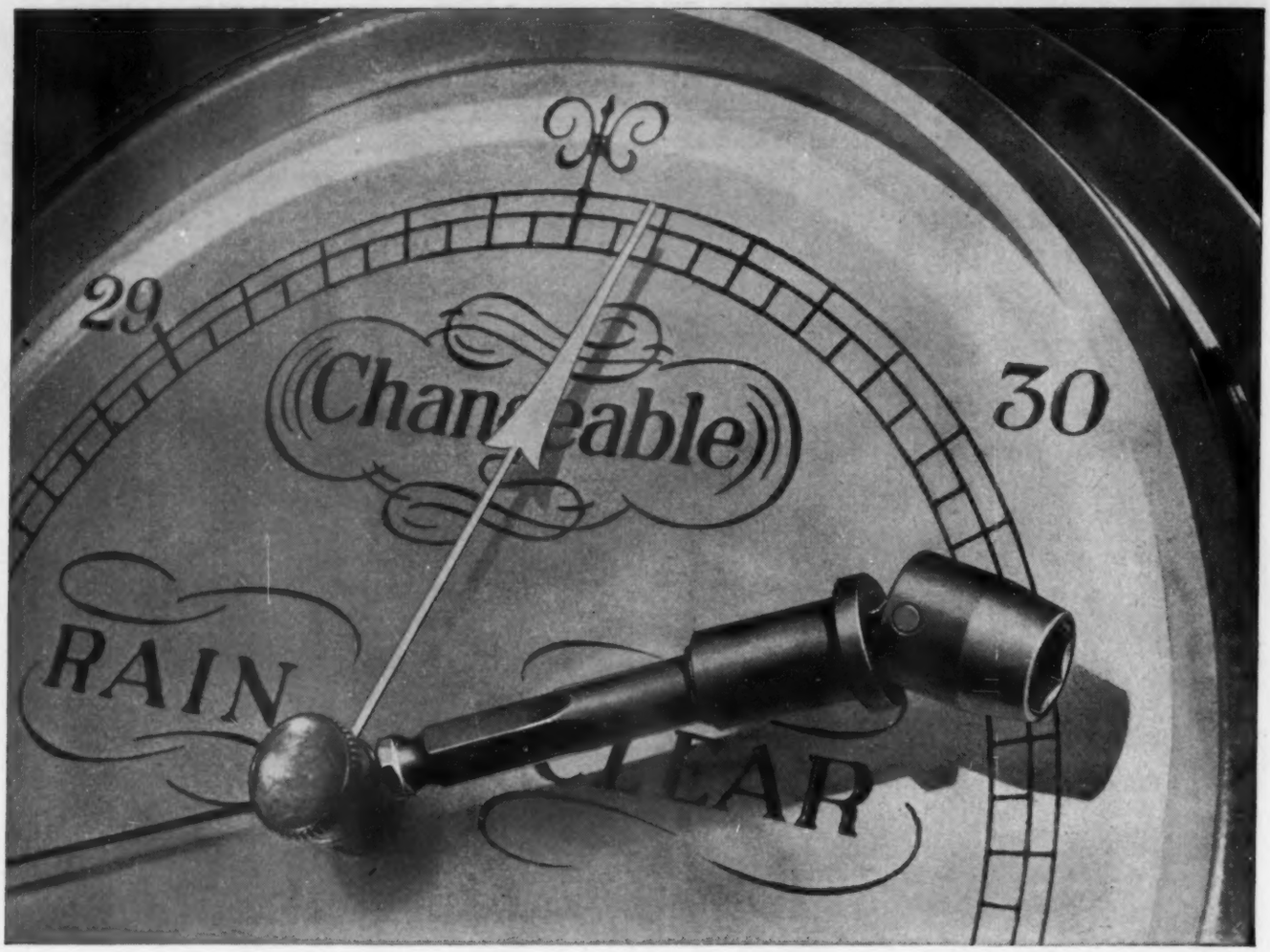

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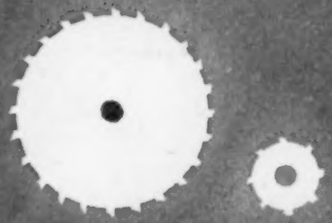

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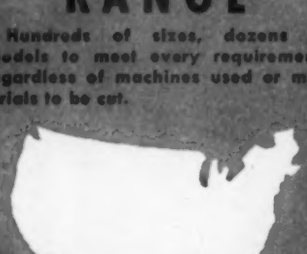

SERVICE

Even special tools use standard parts which are stocked by us. There are 20 Lovejoy service centers throughout the U.S.A. — there is one near you.

30 YEARS' SATISFACTION

Nearly 30 years' continuous experience making milling cutters and other "Positive-Locking" tools. Our first customers are still buying our tools.

The right tool for the job often means a special tool and that usually means an expensive tool. But **not** when you come to Lovejoy, because specials are our specialty—and we offer something extra special when it comes to designing and making them.

Part of that extra-special something is the fact that all our custom-made tools use a majority of **standard** parts. They are built around the famous Lovejoy positive-blade locking device and use Lovejoy interchangeable blades. This means lower initial cost, longer blade life, faster, more accurate production and simpler maintenance. The rest is made up of our nearly thirty years of experience in designing and making all types of inserted-cutter tools and a nationwide service organization that's of real value to owners of Lovejoy special tools, because Lovejoy specials have so many standard parts.

For a few examples of Lovejoy specials, see the illustrations above. They include a rugged dovetail cutter, two face mills—one 24" in diameter, the other 2½" in diameter, a special boring head, and a husky slotting cutter. All use interchangeable carbide-tipped Lovejoy blades.

If your work requires special cutters, you can make no better move than to send your problem to Lovejoy, because specials are our specialty.

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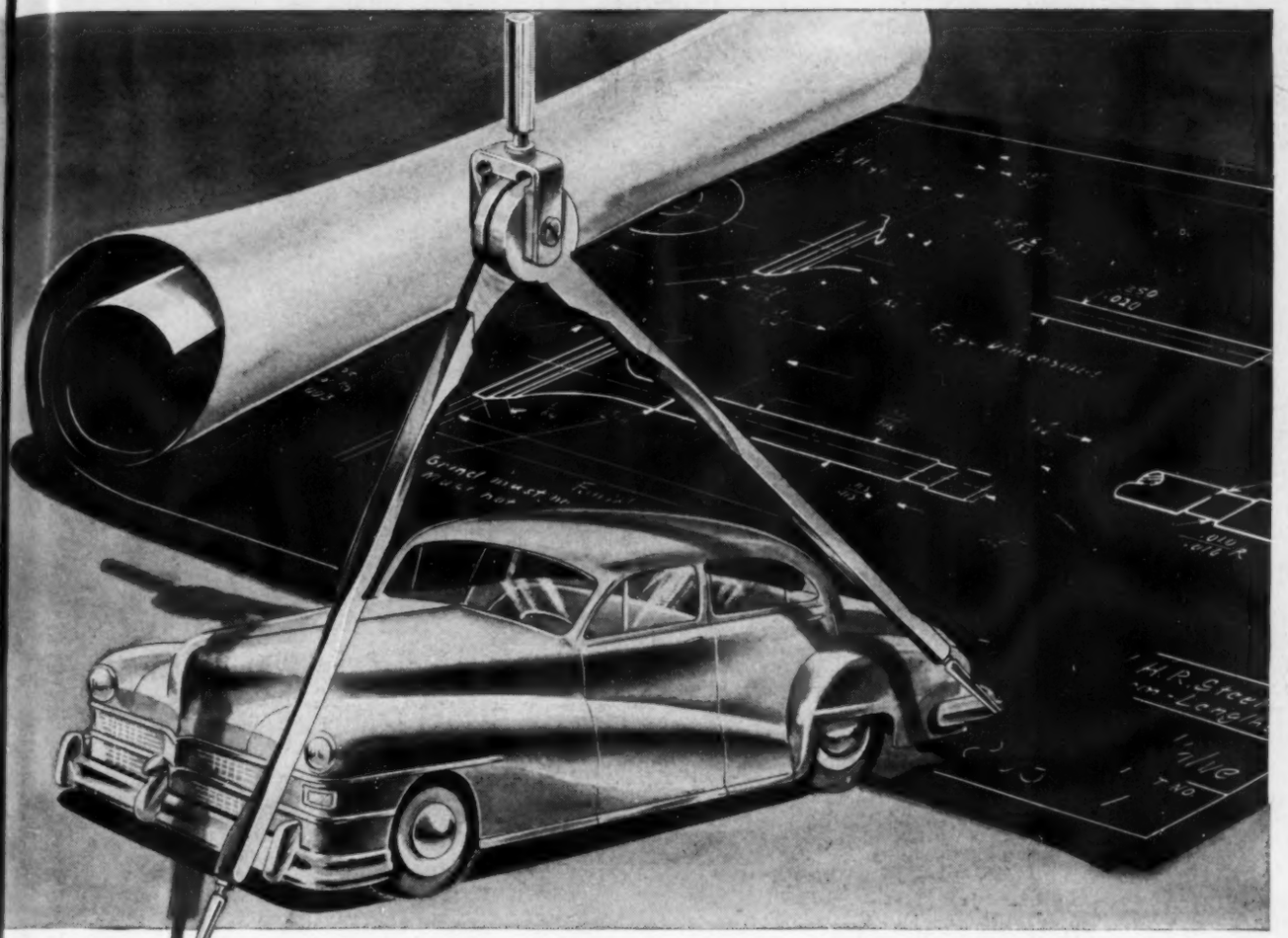

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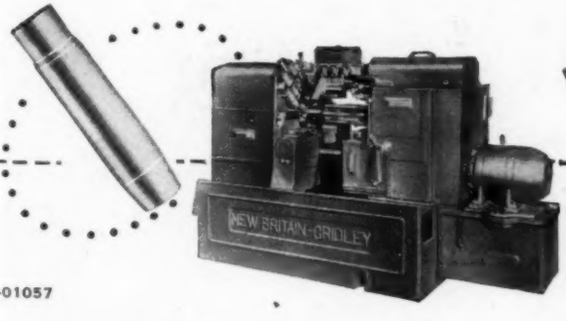

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